UNITED STATES DEPARTMENT OF THE INTERIOR
HAROLD L. ICKES, Secretary
BUREAU OF MINES
JOHN W. FINCH, Director

MINERALS YEARBOOK

1937

Compiled under the supervision of
H. H. HUGHES
Economics and Statistics Branch

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1937

FOREWORD

The activities of the Bureau of Mines fall broadly into three major categories, which complement one another and together constitute a comprehensive and logical program of Government aid in the conservation and orderly development of the national mineral resources. Briefly stated, these activities are grouped as follows: (1) Health and safety work—the improvement of health conditions and the prevention of mine accidents—thus contributing not only to the preservation of life but also to the elimination of the human suffering and economic waste caused by needless accidents; (2) technologic investigations concerning methods used in the mining, preparation, treatment, and utilization of mineral substances, to assist in the more efficient production of minerals and thus promote the conservation of natural resources through the elimination of waste; (3) the compilation and dissemination of basic statistics of the mining industries and the study of economic trends, including all of the phases through which the products of the mines pass before entering into their final uses, thus contributing to the knowledge necessary for the systematic production and conservation of irreplaceable national resources.

Within the last-named group of activities lies one of the most important duties with which the Bureau of Mines has been charged by Congress—that of presenting to the public annually an economic and statistical review of the mineral industries of the United States and the uses to which our mineral wealth is put. The publication of this annual survey of economic developments in the various branches of the mining industry is one of the functions assigned to the Economics and Statistics Branch of the Bureau. The first report in the series of publications presenting the statistics of the mining industry was made under the auspices of the Treasury Department, for the year 1866. The collection of mineral statistics was assigned to the United States Geological Survey upon its establishment in 1879, and was placed on a permanent basis by Congress in 1882. The responsibility for this work was transferred to the Bureau of Mines in 1925. The present *Minerals Yearbook* represents a service of more than 70 years standing and marks the fifty-seventh year of a continuous annual record of economic developments in the mineral industry.

In the 1937 volume have been included the fundamental statistics formerly carried in the statistical appendix. Publication of the appendixes has been discontinued, effecting a considerable saving in cost and an improvement in service in that all essential information is now combined in a single complete volume.

JOHN W. FINCH, *Director*.

JUNE 21, 1937.

CONTENTS

ILLUSTRATIONS

INTRODUCTION

Measured in terms of capital investment, value of products, or number of workers employed, mining ranks last among the four primary industries of the United States. These conventional yardsticks, however, are not altogether accurate indicators of the importance of mining in our national economy. Actually mining is coordinate with manufacturing, agriculture, and transportation because each of these primary industries is critically dependent upon the products of the mines. Manufacturing draws on the minerals both for its machines and for the power to operate them. The products of the mines constitute nearly two-thirds of the revenue freight handled by the railroads and about one-fourth of the ocean-borne traffic. Even agriculture now leans heavily on minerals for its fertilizers and its implements of cultivation and harvesting. Moreover, minerals are necessary to link the farms with the markets. The products of the mines, in fact, form the material basis for modern industry.

With minerals playing so prominent a role in our economic environment, the need for precise information concerning each of the separate branches of the mining industry is at once apparent. Producers and consumers must have the complete facts on production, stocks, consumption, prices, distribution, employment, and other pertinent questions as a basis for intelligent action. The empirical method of guessing will no longer suffice, nor are the essential facts concerning an isolated branch of mining enough. In such a complex economy it is important to know not only how the various branches are interrelated but also how the separate segments interlock into our industrial system as a whole.

To meet the demands for factual data concerning the mineral industries, various agencies of the Federal Government have published periodic surveys for nearly three-quarters of a century. Prior to 1880, the task was assigned to the Treasury Department. During this period the reports were generally on a biennial basis and were primarily concerned with regional mining descriptions. In 1880, the work was transferred to the newly created United States Geological Survey, where it was established on a permanent annual basis. Finally, in 1925 the mineral statistics work was again transferred—this time to the United States Bureau of Mines. These various shifts have resulted in administrative changes, but have not affected the publication of the separate chapters or impaired the continuity of the annual reports.

Although the annual series has remained unbroken since 1880 (this report marks the fifty-seventh annual record), the form and treatment have repeatedly been modified to meet the exigencies of the times. The last major change was in 1933, when the title of the series was changed from *Mineral Resources of the United States* to *Minerals Yearbook* and,

in response to the demand for more timely service, the date of publication was advanced by approximately a year. Another change is introduced with this volume. Since 1933 it has been the practice of the Bureau to issue the complete report as promptly as possible and, for the few industries for which final statistics were not available, to release supplemental chapters giving the detailed figures. These chapters were later assembled and published in bound form as the Statistical Appendix to the Yearbook. As final figures for virtually all branches of the mineral industry except coal, petroleum, stone, and a few others are completed in time for publication in the Yearbook, the practice of issuing the supplementary appendix chapters has been discontinued. For the few industries for which final statistics are not available, the revised and detailed information will be summarized in mimeographed releases and included in the Yearbook for the succeeding year. This change will result in considerable saving and, in addition, will have the advantage of bringing together in a single reference volume all the essential information concerning the mining industry.

Like its predecessors, Minerals Yearbook, 1937, has been made possible by the cooperation of those interested in mining. It is a pleasure to acknowledge the generous support of the thousands of individual producers, distributors, and consumers and of the many public officials and agencies that have supplied information. In addition, the Bureau is indebted to a large number of trade associations for liberal contributions and advice.[1]

Maintenance of continuity of data and uniformity of statistical presentation throughout the Minerals Yearbook volumes has been effected largely through the work of M. B. Clark.

Special thanks are due H. O. Rogers, economic analyst of the Bureau of Labor Statistics, who was loaned to the Bureau of Mines to assist in the final stages of preparation of the manuscript. E. T. Shuey assisted in reviewing and checking statistical chapters. Max Abel supervised the preparation of graphic material, and C. W. Justice helped in many phases of the Yearbook program. M. E. Winslow supplied helpful suggestions for improvement of the individual contributions and, in collaboration with A. B. Brown and E. C. Reid, was responsible for the editing of the entire manuscript.

H. H. HUGHES.

JUNE 21, 1937.

[1] Individuals and agencies cooperating in the Yearbook program are listed in detail in Minerals Yearbook, 1936, p. XI.

PART I. SURVEY OF THE MINERAL INDUSTRIES

REVIEW OF THE MINERAL INDUSTRY

By Richard J. Lund

SUMMARY OUTLINE

Accompanying the vigorous, sustained, and well-diversified business improvement during 1936, the industries engaged in mineral extraction in the United States continued to make marked recoveries from the curtailed activities of depression years. Taking the average for 1923–25 as 100, the Federal Reserve index of total industrial production rose from 90 in 1935 to 105 in 1936, a gain of about 17 percent. On the same basis, the index of mineral production rose about 14 percent—from 91 in 1935 to 104 in 1936. These gains are all the more striking when account is taken of the fact that extraordinarily severe winter weather and disastrous floods caused a mild recession in industrial activity during the first 3 months of 1936. So vigorous was the rise after March that the index of total production stood at 121 for December, which was the highest since October 1929.

The major factor contributing to this gain, and of vital importance in reviving the mineral industries, was the abrupt rise in production of durable goods. (See fig. 1.) The release of pent-up demand was in full swing for such articles as automobiles, busses, trucks, railway passenger and freight cars and rails, locomotives, electric refrigerators, air-conditioning equipment, heavy and light machinery of all types, radios, and dozens of other commodities of the durable type, and many industries in this group established new production records in 1936. Replacement of worn-out and obsolete equipment of all kinds by industry and by private individuals, long postponed during the depression years, became a major force during the year. Destruction of hundreds of millions of dollars in property of various kinds by the widespread floods early in 1936 doubtless contributed to this movement.

Typifying the result of this revival of demand for durable goods was the iron and steel industry, which steadily increased output of ingot steel from about 51 percent of capacity in January 1936 to 78 percent in December; the average for the year was about 68 percent compared with 49 percent in 1935. Not only were increased operations in this

industry illustrative of the effects of such long-dormant needs to replace equipment, but, by its phenomenal expansion in finishing capacity through construction of six huge continuous sheet and wide strip mills in 1936,[1] the steel industry also typified the replacement and modernizing movement itself. Apparently much remains to be done in revivifying such divisions of the industry as coking, blast-furnace, and soaking-pit capacities.[2]

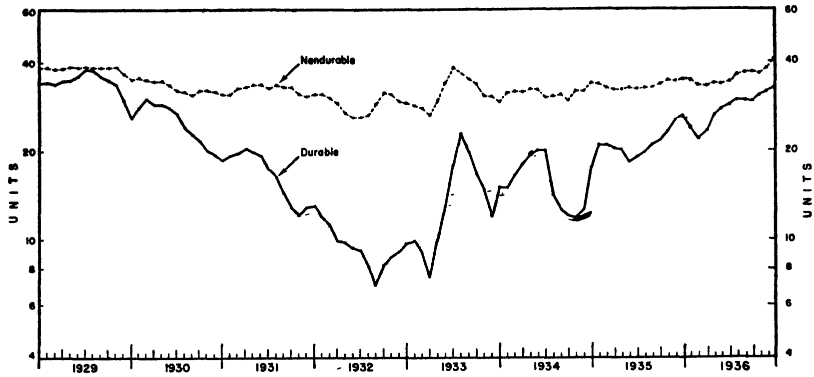


FIGURE 1.—Production of durable manufactures compared with nondurable manufactures, in comparable units and adjusted for seasonal variation, 1929–36. Data compiled by Federal Reserve Board from figures included in its index of manufactures.

Increased earnings by the railroads effected by greater freight and passenger traffic finally permitted expenditure of large sums in replacing freight cars, passenger cars, locomotives, and worn rails. Earlier success in meeting airplane and motorbus competition for passenger traffic by speeding up schedules and modernizing equipment resulted in addition of many more deluxe streamlined Diesel or steam units.

The automotive industry continued its upward climb toward peak production levels with an output of 4,616,857 units (3,807,371 passenger cars and 809,486 trucks and busses), in the United States and Canada. The Canadian production is included, since much of it consists of assembly of parts brought in from the United States. The increase over 1935 is all the more impressive, since that year witnessed the introduction of two new yearly models.

Salient statistics of the American automobile industry, 1929 and 1932–36

	Production						Registration [3]	Exports [4]
	United States and Canada [1]			United States [2]				
	Passenger cars	Trucks	Total	Passenger cars	Trucks	Total		
1929	4,794,898	826,817	5,621,715	4,587,400	771,020	5,358,420	26,501,443	536,207
1932	1,186,185	245,282	1,431,467	1,135,491	235,187	1,370,678	24,115,129	66,404
1933	1,627,361	358,548	1,985,909	1,573,512	346,545	1,920,057	23,843,591	108,027
1934	2,270,566	599,397	2,869,963	2,177,919	575,192	2,753,111	24,933,403	237,880
1935	3,387,806	732,005	4,119,811	3,252,244	694,690	3,946,934	26,230,834	272,761
1936	3,807,371	809,486	4,616,857	3,676,063	778,472	4,454,535	28,221,291	287,810

[1] Figures represent factory sales in United States and production in Canada. Also included are cars assembled in foreign countries from American parts. (Data from Automobile Manufacturers' Association.)
[2] Bureau of the Census.
[3] Bureau of Public Roads.
[4] Bureau of Foreign and Domestic Commerce.

[1] Campbell, T. C., Continuous Strip Mill: Iron Age, Jan. 7, 1937, pp. 131–134.
[2] Knox, J. D., Present Steelmaking Facilities Show Significant Weaknesses If Rush of New Business Continues: Steel, Jan. 4, 1937, pp. 109–116.

Truck and bus production in the United States reached a new record, as did total registration of motor vehicles.

The important role played by the automotive industry in consumption of important minerals is shown in the following table:

Relation of various metals and mineral products used by the automotive industry, in manufacturing and repairs, to total consumption in the United States, 1932–36 in percent[1]

	Steel	Copper	Lead	Zinc	Aluminum	Tin	Nickel	Plate glass	Gasoline	Lubricating oils
1932	17.1	11.1	33.8	6.0	22.9	12.3	28.8	43	85	57
1933	19.2	15.4	35.4	7.1	23.5	11.1	24.0	40	85	57.5
1934	21.0	18.0	38.8	12.2	15.0	13.3	29.6	70	89	59
1935	24.8	20.0	36.8	16.1	20.0	13.2	30.5	76	89	59
1936[2]	21	17	35	15	16	13	28	72	89	59

[1] Steel is compared with total production of finished rolled steel, tin with total deliveries, nickel with total sales, and plate glass with total production of polished plate glass in the United States. (Data from Automobile Facts and Figures (annual volumes), Automobile Manufacturers' Association.)

[2] Preliminary figures.

It should be clearly understood that these data represent percentages used not only in manufacturing new motor vehicles (trucks and busses included), but also in repairs and replacements to old vehicles. Lead going into battery replacements (which in normal times is largely a revolving supply, since old battery plates are remelted and re-formed into new ones with little loss) is the outstanding case of repair or replacement usage. The increase in the zinc figures is worthy of note, as it was doubtless brought about by the expanded use of zinc die castings for decorative features and other intricate, unstressed parts. The employment of steel in motor vehicles needs no further explanation, except perhaps notation of the fact that the movement toward all-steel bodies and streamlining has tended to raise the amount of steel used per pound of car weight. It has been estimated[3] that about 150 pounds more steel per car was used in 1936 than in 1935. Copper is the chief constituent of the radiator and electrical parts; tin and lead are in the solder in the radiator and in the numerous bearings; aluminum is in pistons, crankcases, and cylinder heads of many models; and nickel is in special alloy steel or iron used in such highly stressed parts as shafts, gears, steering apparatus, and crankshafts, and as an undercoating for chrome-plated equipment.

An infant branch of the automotive industry, progressing by leaps and bounds, is the passenger trailer business. Production totaled about 60,000 units in 1936 compared with 27,500 in 1935; estimates for 1937 production are around 80,000 units. Possible limitations on the future trailer market and other interesting features of the business were discussed by Applegate.[4]

The position of utility corporations, large consumers of fuels and copper, was improved in 1936 by a new record in electricity production. A total of 114 billion kilowatt-hours of electricity was produced compared with 99 billion in 1935 and 97 billion in 1929. The ratio of 64 percent generated by fuel power and 36 by water power in 1936 was almost identical with 1929, but represented a small gain for fuel power

[3] Steel, Automobiles: Jan. 4, 1937, p. 260.

[4] Applegate, La Rue, Trailer Production Shows Phenomenal Growth Typical of "Infant Industries": Annalist, Mar. 26, 1937, p. 475.

compared with 1935. Consumption of gas in electricity generation reached a new record figure of 156 billion cubic feet in 1936. The steady trend toward better conversion efficiency was continued in 1936 by a reduction in consumption of coal and coal equivalent of other fuels per kilowatt-hour generated to 1.44 pounds. Comparable amounts were 1.46 pounds in 1935, 1.69 pounds in 1929, and 3.2 pounds in 1919.[5] Recent development of a new type of high-pressure steam turbine that generates additional current while still delivering enough exhaust steam to existing generators to keep them in normal operation has permitted increased output with only modest capital expenditure.[6] To what extent a new type of multiple cable [7] may affect the demand for copper for telephone lines in the future is difficult to say. Competition by aluminum doubtless was a factor in the development of a new type of hollow copper cable to transmit current of record high voltage from Boulder Dam to Los Angeles.[8]

Although still far below normal in activity, the construction industry made important gains in 1936, which aided materially in the business revival. The Federal Reserve index for value of total construction contracts awarded (based on data from F. W. Dodge Corporation) rose to 55 in 1936 compared with 37 in 1935 (1923–25 average=100), an increase of about 49 percent. Though achieving substantial gains in 1936, residential building lagged far behind all other types of construction activity combined. As a result of the comparatively low volume of construction, mineral industries supplying materials primarily used in building, such as brick, cement, lime, sand and gravel, gypsum, and building stone, were still considerably depressed. The possibility that construction costs would advance at a more rapid rate than income of potential builders threatened to curb effectively the upward trend now under way.

The farmers' situation continued to improve, in spite of another drought year, with a cash income estimated by the Bureau of Agricultural Economics at $8,100,000,000 in 1936, compared with $7,201,000,000 in 1935 and $10,417,000,000 in 1929. This gain in his income was much greater than the rise in cost of manufactured goods he consumes, judging from available indexes, thus raising his net income and purchasing power. Mineral industries benefiting directly from increased farm income are those engaged in producing phosphate and potash (for fertilizers) and arsenic (for insecticides). Indirectly, the great majority of mineral industries gain through the farmers' larger purchases of automobiles, trucks, tractors, farm implements, gasoline, radios, electrical machinery, fencing, and the many other manufactured articles needed to improve his living and working conditions.

Improvement of conditions in these several domestic industries has been cited to show the basic reason for improvement in the mineral industries with which this volume is directly concerned.

The story is not complete, however, without a reference to increased foreign trade as an additional factor in recovery of the mineral extraction and processing enterprises. Exports of minerals, metals, and products (except gold, silver, and some minerals classed as chemicals,

[5] Federal Power Commission, Monthly and Annual Production of Electricity for Public Use in the United States in 1936: Apr. 12, 1937.

[6] Ellsworth, D. W., Operating Expenses of Electric Utilities Again Rise Faster Than Revenue: Annalist, Jan. 22, 1937, p. 110.

[7] Nation's Business, One Cable—240 Conversations: April 1937, p. 28.

[8] National City Bank of New York, Economic Conditions, Governmental Finance, United States Securities: June 1936, pp. 89–90.

together with machinery and motor vehicles) increased to $597,000,000 in 1936, compared with $536,000,000 in 1935 and $1,276,000,000 in 1929. Imports increased at a more rapid rate to $332,000,000 compared with $281,000,000 in 1935 and $702,000,000 in 1929. These totals for imports include the value of materials imported in bond for refining and export (important in the case of copper and less so in oil and other commodities), since these values automatically are listed by the Bureau of Foreign and Domestic Commerce as a domestic export, inasmuch as their form has been changed. Improvement in foreign trade in minerals is attributed to various factors, chiefly improved industrial conditions throughout the world, rearmament, and the effect of reciprocal trade agreements already negotiated by the United States acting as a wedge, at least, in the huge task of breaking down artificial and costly trade barriers.

Industrial employment and pay rolls in 1936 increased steadily and at a more rapid rate than the cost of living, resulting in a considerable increase in real wages to the average worker. Judging from Department of Labor indexes, the greatest increase in employment in important mineral-extraction industries was made in metalliferous mining, but substantial pay-roll gains were registered both in metalliferous and bituminous-coal mining. Unemployment, although considerably reduced, was still an important unsolved problem.

A continued moderate rise in annual average commodity prices in 1936 was led by raw materials and semimanufactured goods, both of which rose in price more rapidly than did finished products. Starting late in 1936, both ferrous and the common nonferrous metals began a spectacular price rise, which continued unabated into the first quarter of 1937. These advances represented in part the results of increasing costs of labor and materials used in their production, but for nonferrous metals the control was completely in the hands of the London Metal Exchange. War fears, with concomitant record peacetime rearmament programs, together with considerable speculative dealing, provided the impetus for the runaway market that developed in London for copper and lead and later for zinc and tin. Heavy forward buying, precipitated by the conviction that the upward trend would continue, accompanied the movement.

In general, stocks of important minerals and metals, particularly copper, lead, and zinc, in the United States were reduced materially in 1936. Bituminous-coal stocks in the hands of consumers and visible tin stocks were important exceptions; both rose substantially.

PRODUCTION

Trends in the production of important minerals and metals, plotted on ratio paper for convenient comparison of relative rate of change between different commodities, are shown for 1927–36 in figure 2. For the common metals, the figures represent primary production from domestic ores, with no secondary metal included. Aluminum gained most rapidly, with an increase of 88 percent, over 1935 production, copper followed with a 61-percent increase, and iron ore was a close third with a rise of 59 percent. Anthracite, with a gain of only 5 percent over 1935, made the poorest showing. New all-time records were made in production of crude petroleum and natural gas, whereas aluminum remained practically at the 1929 level and just below the 1930 record output. Silver output was back to the levels of the late

twenties, though still 20 percent below the record 1915 production; and gold output (including the Philippine Islands) was the best since 1916 and only 12 percent below the 1915 peak production. Compared with 1929 levels of output lead in 1936 still showed the poorest net recovery. The marked rise in output of bituminous coal reflected the spurt in iron and steel activity, increased power consumption, and the rise in commercial stocks.

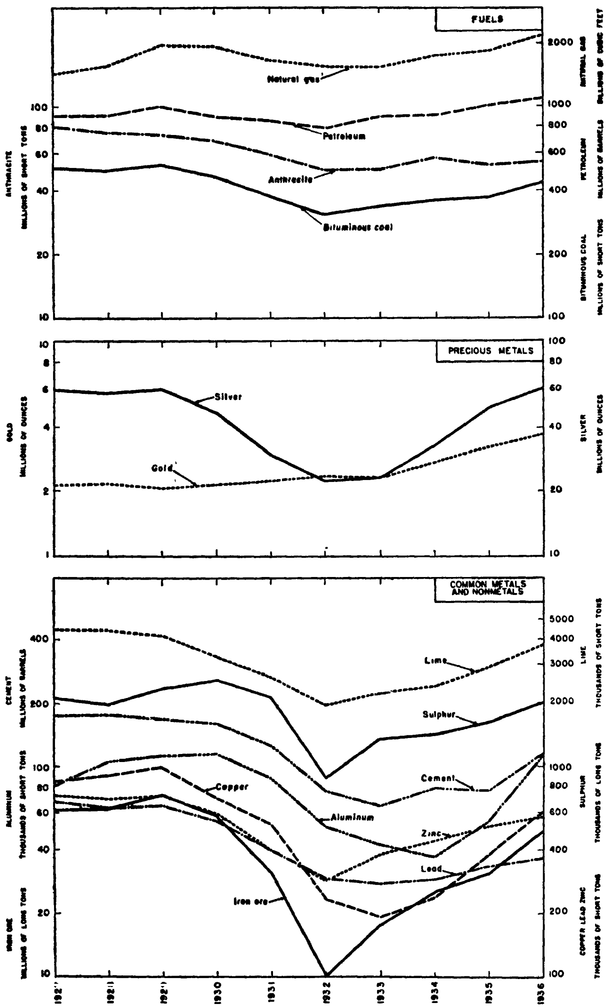


FIGURE 2.—Trends in production of important minerals and metals in the United States, 1927-36.

Trends in the production of minerals compared with the output of automobiles, iron and steel, and all manufactures, as indicated by index numbers compiled by the Federal Reserve Board, are shown in figure 3. The relative rise in 1936, compared with 1935, was virtually the same for minerals, automobiles, and all manufactures; the increase in iron and steel production far surpassed gains in the other fields shown. The monthly production record in 1936 of all minerals, total manu-

factures, iron and steel, automobiles, and cement, together with value of construction contracts awarded, as indicated by adjusted index numbers of the same agency, are shown in figure 4. Except for cement and construction contracts, most of the production levels lie slightly or well above the 1923–25 monthly average; the spectacular record of iron and steel is again evident.

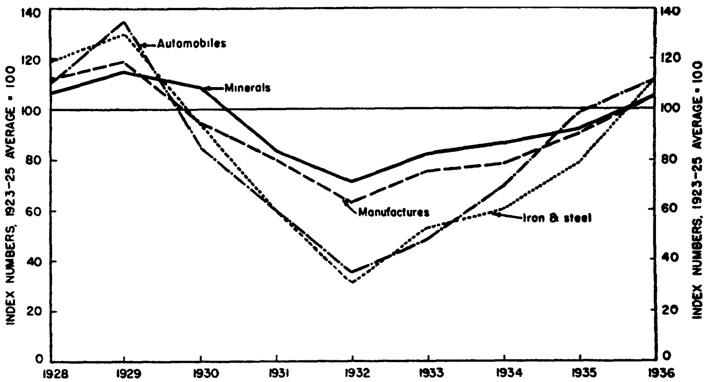


FIGURE 3.—Comparison of trends of physical volume of production for minerals, iron and steel, automobiles, and all manufactures in the United States, 1928–36. All indexes from Federal Reserve Board data.

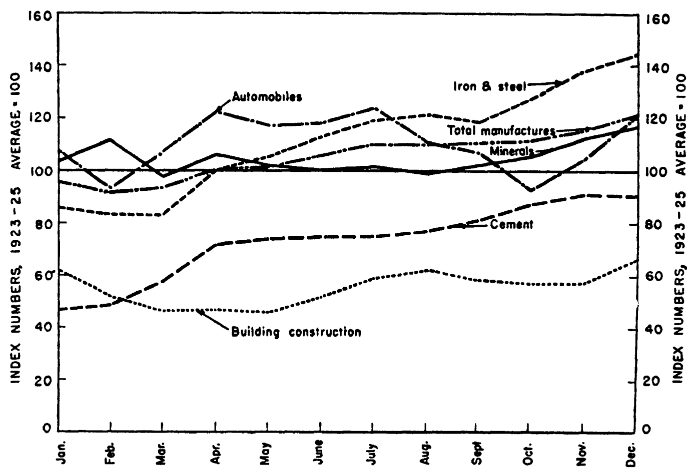


FIGURE 4.—Comparison of trends of physical volume of production for minerals, total manufactures, iron and steel, automobiles, and cement, and the value of construction contracts awarded in the United States in 1936, by months. All data from Federal Reserve Board; indexes adjusted for seasonal variation.

PRICES

Price trends of important minerals for 1927–36, on ratio paper for convenient comparison, appear in figure 5. The figures used in most instances represent average unit value received by the producers rather than average market quotations. The most marked increases for 1936 over 1935 are accredited to copper and zinc, with silver and lead only slightly behind. Probably the most striking feature of prices in the entire mineral field during 1936 was the control exercised over the copper and lead markets by the London Metal Exchange

during the latter part of the year and extending into 1937. General business revival, effected in part by record rearmament activities, coupled with recurring crises threatening world peace, made a perfect background for speculators, and prices for copper and lead started a pronounced upward climb during the latter part of 1936, culminating in an even more spectacular rise early in 1937, when zinc and tin followed suit. The average monthly price for electrolytic copper c. i. f. European ports rose from 9.10 cents per pound in June to 11.13

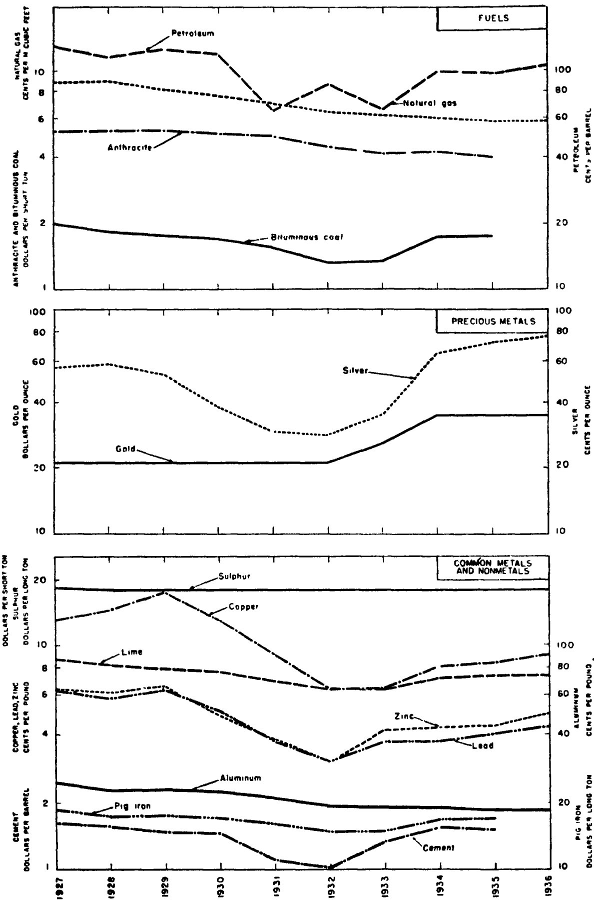


FIGURE 5.—Price trends of important minerals in the United States, 1927-36.

cents in December; pig lead for New York delivery rose from an average of 4.60 cents per pound in October to 5.55 cents in December. Zinc prices were sluggish in comparison, having risen only from an average of 5.16 cents per pound, New York, for prime western, in July to 5.65 cents in December. Much of the tonnage of copper produced during the latter part of the year doubtless was sold at prices substantially below those prevailing in the open market at the time of delivery, since heavy forward buying was made below the 10-cent level in midyear. Each advance in the London price was followed by a boost in the New York price, presumably to insure domestic con-

sumption of domestic copper supplies. This resulted in what was referred to by The London Mining Journal as a "vicious circle * * * of competitive advances between New York and London * * *."

Trends in the prices of fuels, metals, and cement compared with prices of all commodities, 1928–36, as measured by index numbers compiled by the Bureau of Labor Statistics, are shown in figures 6

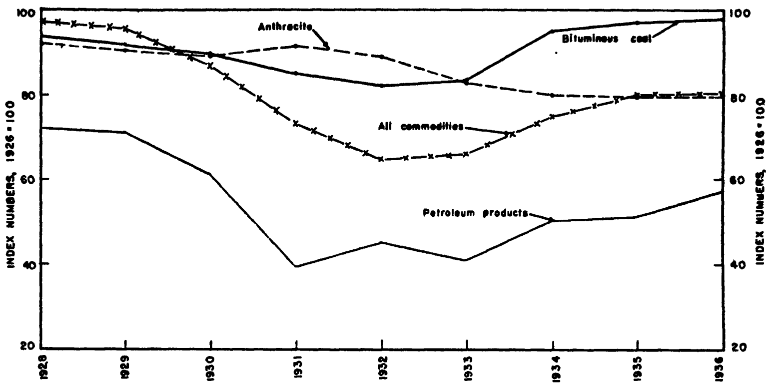


FIGURE 6.—Comparison of trends of prices of mineral fuels and of all commodities in the United States, 1928–36. All data from Bureau of Labor Statistics.

and 7. The index for prices of petroleum products appears relatively low, because 1926, used as a base, witnessed the highest levels of petroleum prices since 1920.

The effect of the price rises of late 1936 in reopening dormant, relatively high-cost operations was not evident immediately, although announcements made at the year's end by several companies forecast

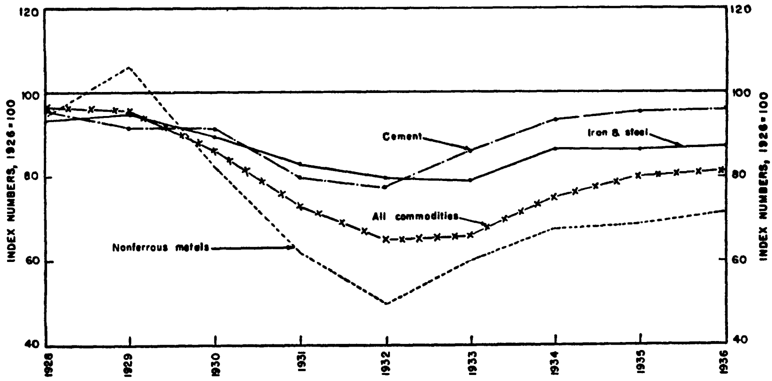


FIGURE 7.—Comparison of trends of prices of metals and cement and of all commodities in the United States, 1928–36. All data from Bureau of Labor Statistics.

a pronounced movement in this direction in 1937. Production at mines already in operation was increased gradually to practical capacity near the close of the year. It is almost axiomatic that greatest production occurs under high prices, and the smallest production under low prices. How well this statement is borne out for six important mineral commodities is shown in figure 8, in which production is plotted as ordinates and price as abscissas on separate charts for

copper, lead, zinc, portland cement, bituminous coal, and petroleum for 1922–36. Reasonably good straight-line trends from large production at high prices to small production at low prices are shown for copper, lead, zinc, and bituminous coal. Portland cement described a rather wide orbit, counterclockwise, as points were plotted from the early twenties to the middle thirties, the significant feature being the trend in the late twenties toward higher production at decreasing prices. The trend displayed by petroleum appears contrary to that shown by most of the other commodities, with a distinct tendency toward higher production at lower prices.

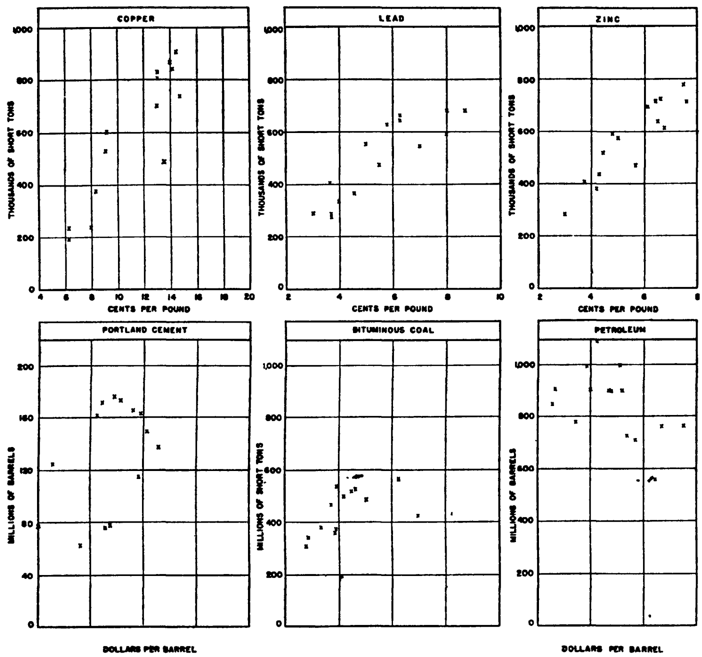


FIGURE 8.—Production at price, of important mineral commodities, 1923–36. Prices of portland cement and bituminous coal for 1936 not yet available and the 1936 point for each of these commodities is therefore omitted from the chart.

STOCKS

The tendency in 1936 toward reduction in stocks of important minerals was particularly marked for those held by producers of copper, lead, and zinc. (See fig. 9.) At the end of 1936 zinc stocks represented little better than a month's supply. The decrease in lead stocks was not quite as large, proportionately, as the depletion of copper and zinc stocks, but it was a healthy sign of improvement of the decidedly unhealthy stock situation as regards lead that still prevailed at the end of 1935. It should be clearly indicated that a considerable part of the reduction of producers' stocks of copper, lead, and zinc may have been and probably was accounted for by transfers to invisible stocks held in the hands of consumers. Unfortunately, no data are available to aid in exactly solving this problem, but reports from reliable sources indicate that for copper, such transfer of stocks was considerable. Visible supplies of tin in the United States, which had dropped to a very low level at the close of 1935, were at a much higher level at the end of 1936 but still represented

less than a month's supply. Bituminous coal held by consumers continued the increase evident since 1932. Uncertainty as to future supplies, due to the troubled labor situation at the close of the year, doubtless contributed to the increase of stocks. Stocks of iron ore at furnaces and lower lake ports, although slightly larger than at the close of 1935, were much lower than during the middle and late twenties. Stocks of iron ore at the mines, mainly in Michigan and Minnesota, were the smallest since 1907.

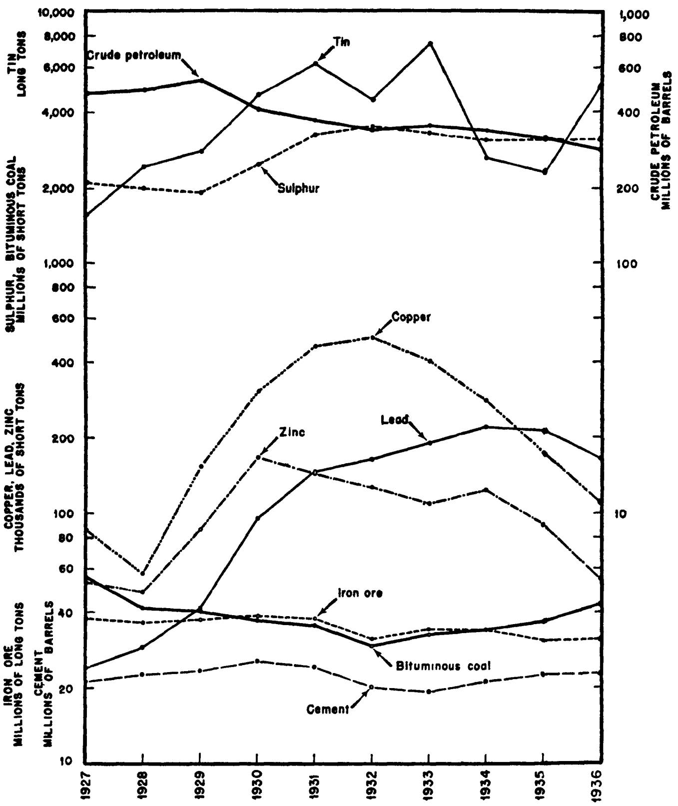


FIGURE 9.—Trends in mineral stocks in the United States, 1927–36.

EMPLOYMENT AND PAY ROLLS

Measured by the index numbers compiled by the Bureau of Labor Statistics, employment in mineral-extraction industries was still far below that in the entire manufacturing group in the upward move back to 1929 levels. Anthracite, metalliferous, and nonmetalliferous mining (including quarrying) still employed only 50 to 60 percent as many men as in 1929. Bituminous-coal mining and crude-petroleum-producing industries, while considerably better than the group cited, were still 20 to 25 percent below 1929 figures. Industries closely related to mining, including smelting and refining of metals and petroleum refining, showed in general a better record of employment than did all manufacturing. Employment in the cement industry was still about 36 percent less than in 1929.

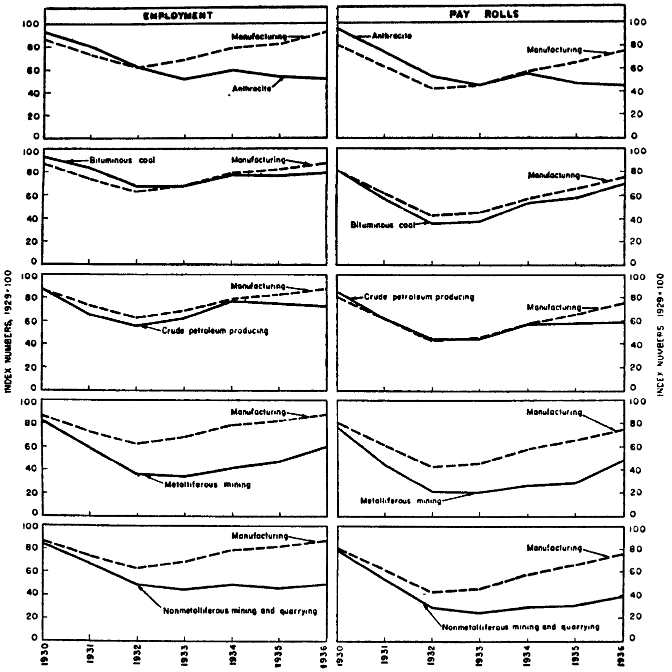


FIGURE 10.—Trends in employment and pay rolls in mineral-extractive industries compared with all manufacturing industries, 1930–36. All data from Bureau of Labor Statistics; manufacturing indexes converted to 1929 as 100.

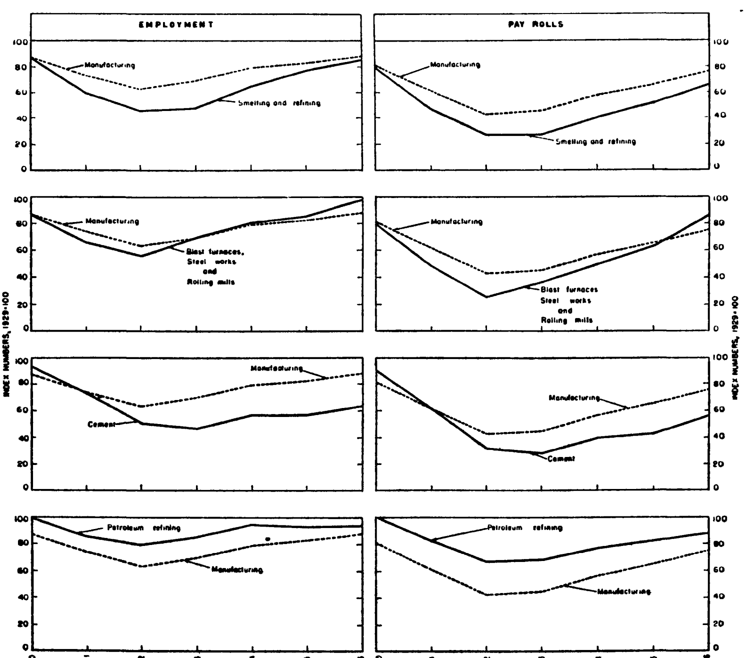


FIGURE 11.—Trends in employment and pay rolls in industries closely associated with mineral extraction compared with all manufacturing industries, 1930–36. Indexes converted to 1929 as 100.

The pay-roll trends follow fairly closely those for employment in the industries cited. Trends of employment and pay rolls in mineral-extractive industries compared with manufacturing for 1930–36, are shown in figure 10 and those for closely associated industries may be found in figure 11. The index numbers used in constructing the charts appear in the following table:

Indexes of employment and pay rolls in mining and associated industries compared with indexes of employment in all manufacturing industries, 1930–36 [1]

[1929=100]

Industry	1930	1931	1932	1933	1934	1935	1936
Employment:							
Mineral extraction:							
Anthracite mining	93.4	80.5	62.5	51.7	59.6	53.2	51.8
Bituminous-coal mining	93.4	83.2	67.4	67.9	77.2	76.7	79.0
Crude-petroleum production	87.4	65.7	55.3	62.2	77.7	74.9	72.9
Metalliferous mining	83.2	59.1	36.5	34.6	41.6	47.3	60.3
Quarrying and nonmetallic mining	84.3	67.4	49.0	44.9	48.9	46.0	49.5
Associated industries:							
Smelting and refining [2]	87.0	59.6	45.3	47.0	64.7	76.9	85.5
Blast furnaces, steel works, and rolling mills	87.5	66.3	56.0	68.8	81.0	85.7	97.8
Cement manufacturing	93.7	72.9	50.7	47.4	57.3	57.6	63.6
Petroleum refining	100.4	85.4	79.3	85.6	95.1	93.8	95.1
All manufacturing	87.2	73.8	62.6	68.8	78.8	82.1	87.8
Pay rolls:							
Mineral extraction:							
Anthracite mining	95.3	75.4	53.7	45.8	55.9	47.5	45.7
Bituminous-coal mining	81.3	57.5	35.6	37.8	54.2	58.2	70.8
Crude-petroleum production	85.9	61.7	44.1	44.1	56.9	57.9	58.6
Metalliferous mining	78.0	44.8	21.6	20.6	26.7	33.9	48.4
Quarrying and nonmetallic mining	79.3	53.4	29.1	24.7	29.6	30.7	38.9
Associated industries:							
Smelting and refining [2]	79.5	46.2	26.8	27.6	40.0	51.1	63.9
Blast furnaces, steel works, and rolling mills	80.0	48.9	25.0	37.0	50.5	63.7	85.4
Cement manufacturing	89.8	61.2	32.1	28.4	40.6	42.7	55.5
Petroleum refining	100.9	81.9	67.7	68.4	77.6	81.7	87.0
All manufacturing	81.1	61.8	42.5	45.3	57.7	65.4	75.5

[1] All data from Bureau of Labor Statistics. Indexes for industries associated with mining and for manufacturing converted to 1929 as 100.
[2] Copper, lead, and zinc smelting and refining.

During 1936 the Bureau of Mines cooperated with the Census of Business in a canvass of mines and quarries for 1935 data on the most important items usually obtained in the decennial census of mines and quarries, including employment. Preliminary reports for various mineral industries have already been released, but summarized data for the entire mining and quarrying industry are still unavailable.

In October 1935 a National Research Program was established under the Works Progress Administration to collect and analyze information bearing on problems of employment, unemployment, and relief; and in December 1935 the individual project on Reemployment Opportunities and Recent Changes in Industrial Techniques was organized to inquire into the extent of recent changes in industrial techniques and to evaluate the effect of these changes on the volume of employment and unemployment. Aid of industry, labor, and Government and private agencies was enlisted; and since early in 1936 the Bureau of Mines has cooperated in the study of these problems as related to the mineral extractive industries.

Detailed study has been made of a considerable number of mineral industries wherein employment is a significant factor in the national picture, including coal, oil, iron, copper, lead, zinc, and silver, gold, cement, phosphate rock, gypsum, and stone. The general procedure

followed was to correlate employment and production data over a period of years to determine the trend of labor productivity in terms of units of material produced per man-hour or man-shift, followed by a study of the numerous variable factors important in determining the productivity trends. These studies are nearly completed, and some of the salient facts available are described in the chapter on Progress in Mine Mechanization.

A report [9] issued early in 1937 summarized the problems in the study and presented preliminary findings for inclusion in the recent report of The National Resources Committee on Technological Trends and Their Social Implications. Exploratory trends presented on page 36 of the Weintraub report indicate that in mining, about 20 percent less labor would have been required for the same output in 1934 as was needed in 1920; and in manufacturing, about 44 percent less labor would have been needed in 1934 as was required in 1920 for the same output. Detailed results of these various productivity and employment studies will probably be available late in 1937.

An important phase of the study relating to the mineral extractive industries consisted of a resurvey of mechanical loading in underground and surface mines and quarries. Preliminary facts obtained on underground mechanical loading were presented in a recent paper.[10]

The first of the reports on the mineral industries released by this cooperative project appeared late in April 1937 [11] and served as an introductory bird's-eye view to the problems to be discussed in greater detail for separate mineral industries in later reports. Tryon sums up the outlook for the next 10 years as follows:

> In coal mining the forces making for labor displacement are strong enough to be a cause of some concern. In metal mining, also, the chances of expansion (in employment) beyond the level of the 1920's seem unfavorable. In oil and gas, on the other hand, the trends point to an increase in (total) labor requirements. * * * Taking the mineral industries as a group, there seems little chance that the total demand for labor will rise greatly above the levels of the 1920's.

INCOME

Price increases for minerals and products, together with almost full capacity operations during the latter part of the year, caused a marked rise in the earnings of industries engaged in mineral extraction in 1936. The influence of the amount of output in controlling net income is a very important factor in mining, where overhead commonly is large on operations, whether they produce at high or low rates.

Preliminary figures compiled by the Bureau of Mines from data for individual companies published by Standard Statistics Co. reveal that 78 large companies engaged in mineral extraction and processing had a total net income of $646,511,000 in 1936 compared with $349,586,000 in 1935, an increase of about 85 percent. The total invested capital in 1935 was $11,319,830,000, so that the proportion of net income to invested capital was about 5.7 percent in 1936, compared with 3.1 percent in 1935. These figures compare with an estimated proportion

[9] Weintraub, David, and Posner, Harold L., Unemployment and Increasing Productivity: National Research Project on Reemployment Opportunities and Recent Changes in Industrial Techniques, Philadelphia, Pa., March 1937, 75 pp.

[10] Plein, L. N., Berquist, F. E., and Tryon, F. G., Mechanical Loading Underground—A New Survey: Eng. and Min. Jour., vol. 138, no. 5, 1937, p. 241.

[11] Tryon, F. G., Read, T. T., Heald, K. C., Rice, G. S., and Bowles, Oliver, Technology and the Mineral Industries: Rept. E-1, Mineral-Technology and Output-per-Man Studies, National Research Project, WPA, in cooperation with the U. S. Bureau of Mines, Philadelphia, Pa., April 1937.

of earnings to invested capital of 9.2 percent for 403 industrial companies in 1936 compared with 5.9 percent in 1935. The 1929 figures were 8.8 percent for the same companies engaged in mineral extraction and processing and 10.6 percent for the same 403 industrial companies; the 1932 lows were —0.9 and 0.3 percent, respectively. Although earnings fell at a more rapid rate for mineral industries than for all industries during the depression, recovery has taken place at a faster pace also. The relative position of different branches of the mineral industry with regard to the relationship between net income and invested capital during the past 10 years is shown in the following table:

Percentage of net income or loss on invested capital of companies operating in various branches of the mining industry and in all industry, 1927–36 [1]

Industry	Number of companies	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936 [2]
Coal	7	−0.7	1.1	1.3	1.1	0.4	−1.6	−1.7	0.5	−1.7	−1.2
Oil producing and refining	26	4.7	8.8	8.8	3.9	−.9	1.1	1.5	2.7	4.3	6.9
Iron and steel	18	4.0	5.0	8.4	3.8	−.8	−3.6	−1.8	−.6	.8	3.4
Nonferrous metals:											
Copper, lead, and zinc	13	6.7	12.5	14.4	2.9	−.4	−3.6	−.1	1.6	3.8	7.1
Miscellaneous	8	7.1	9.1	10.0	4.8	1.0	−1.6	2.2	3.8	6.4	9.4
Total nonferrous metals	21	6.9	11.1	12.6	3.7	.2	−2.7	.8	2.5	4.8	8.0
Asphalt and cement	6	7.6	7.1	6.3	5.4	.1	−3.5	−2.2	−.2	------	3.6
Total minerals	78	4.6	7.6	8.8	3.9	−.5	−.9	.3	1.6	3.1	5.7
All industrial	403	8.0	10.0	10.6	6.0	2.3	.3	2.5	3.9	5.9	[3] 9.2

[1] Compiled from data published by Standard Statistics Co. Net income represents amount available after depreciation and fixed charges. Total invested capital includes funded debt, common and preferred stock, capital reserves, and surplus.

[2] Estimated by the Bureau of Mines on the basis of data for individual companies published by Standard Statistics Co.

[3] Estimate based on the percent increase in profits of 933 corporations from 1935 to 1936, as shown by the Federal Reserve Bank of New York.

Coal companies in 1936 were still unable to show a consolidated net operating income; iron and steel and asphalt and cement companies exhibited modest returns of about 3.5 percent; oil producing and refining and common nonferrous metals (copper, lead, and zinc) producing companies earned returns of about 7 percent; and the highest returns, 9.4 percent, were made by a group of companies producing miscellaneous nonferrous metals. The greatest improvement in 1936 compared with 1935, was achieved by the iron and steel group, which attained better than a 400-percent increase.

It should be borne in mind that these figures represent only a sample of the entire mineral industry, and, furthermore, that a significant proportion of the companies included in the sample represents completely integrated units, from the mining of raw materials to the marketing of finished manufactured products. As an example, the 26 oil-producing companies, most of which are important refiners and marketers of products, earned about 67 percent of the net income in 1936 of the 78 mineral companies included in the sample.

Quite a different picture is revealed by the records of the Bureau of Internal Revenue, United States Treasury Department. Salient features of income, assets, and dividend payments of companies engaged in mining and quarrying, in manufacturing, and in construction are shown in the following table and in figures 12, 13, and 14.

Net income or deficit of corporations engaged in mining and quarrying, total manufacturing, and construction, 1924–34, in millions of dollars [1]

Industry	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934
Mining and quarrying	−66.9	243.6	272.3	29.4	125.3	232.1	−44.3	−254.8	−224.4	−176.4	−8.6
All manufacturing	2,763.5	3,701.1	3,708.1	3,087.6	3,910.5	4,405.8	1,117.7	−823.0	−1,806.4	204.0	978.4
Construction	90.7	113.1	108.9	111.7	99.5	108.3	68.1	−30.3	−110.4	−67.8	−34.4

[1] All data from Statistics of Income (annual volumes), Bureau of Internal Revenue.

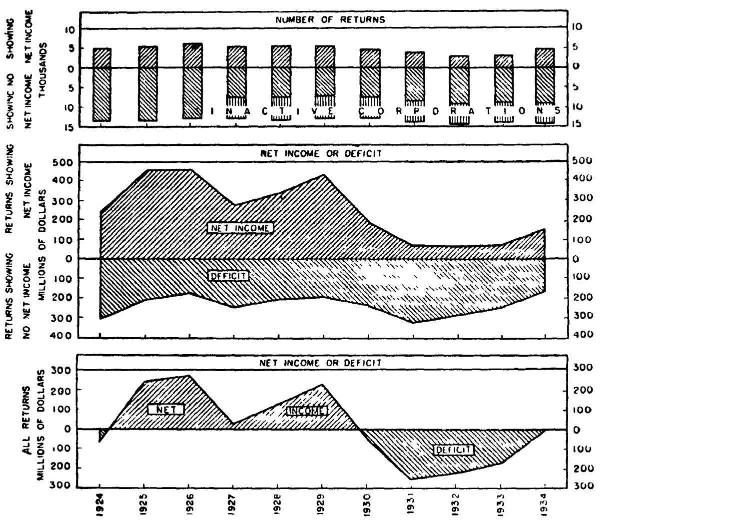


FIGURE 12.—Financial status of mining corporations in the United States, 1924–34. Data from Bureau of Internal Revenue.

It should be stated and emphasized at the outset that these statistics are not comparable with those included in the sample previously cited. The main feature in which they differ is that the sample includes large integrated steel and oil-refining industries under mining, whereas the Bureau of Internal Revenue includes these as subgroups under manufacturing. Although information on the net income of these subgroups is available in published form data on the total assets or liabilities and total cash and stock dividends declared by companies classified as subgroups under manufacturing are not available from published sources. Because of this, it was impossible to add these to the mineral extractive group to obtain better comparability.

Another feature in which the two sets of figures may differ materially is in the methods of determining what constitutes "net income." The figures taken from reports of the Bureau of Internal Revenue represent "statutory net income less statutory deficit" and do not include tax-exempt income under receipts or Federal income tax under deductions. Net income as generally computed by corporations in their operations reports includes the tax-exempt income under receipts and also the Federal income tax under deductions. Also, a few companies included in the sample report net income before depletion and other miscellaneous charges.

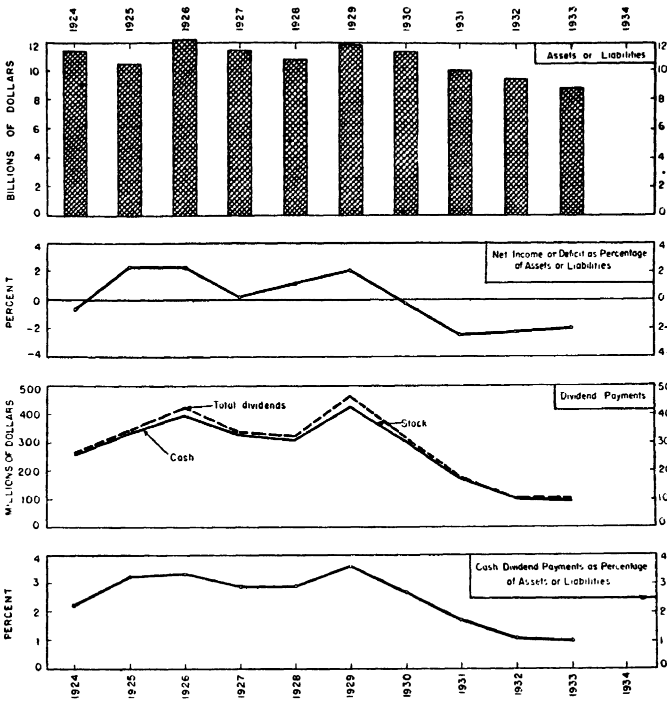


FIGURE 13.—Assets or liabilities, net income or deficit as percentage of assets or liabilities, dividend payments and cash dividend payments as percentage of assets or liabilities of mining corporations in the United States, 1924–33. Data from Bureau of Internal Revenue

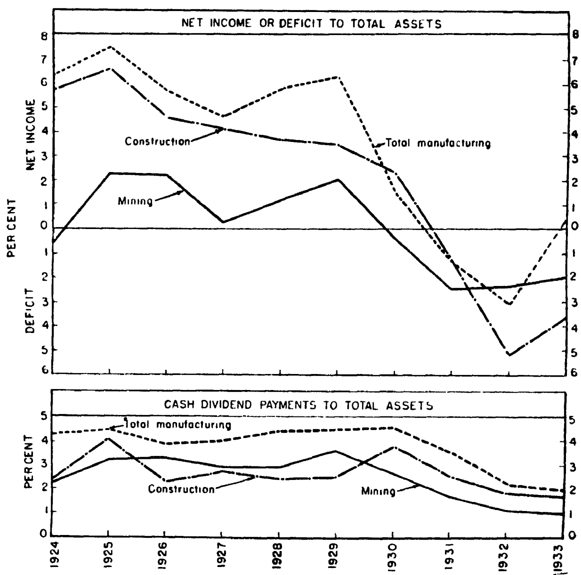


FIGURE 14.—Net income or deficit, and cash dividend payments expressed as percentage of total assets or liabilities for mining, all manufacturing, and construction industries in the United States, 1924–33. Data from Bureau of Internal Revenue.

Despite limitations in comparing the two sets of figures and lack of details in Internal Revenue figures later than 1933, the data are presented to indicate general trends in important financial items for mining, manufacturing, and construction corporations for the 10 most recent years for which details are available.

The assets or liabilities shown include only those corporations that submit balance sheets. The percentages of net income or cash dividend payments to total assets for the different industrial groups shown are therefore a bit too high, since net income or cash dividend payments are totals for all corporations reporting, whether or not they submitted balance sheets. The difference is small, however, inasmuch as net income or deficit of corporations submitting balance sheets generally amounts to well over 90 percent of the total net income or deficit of all corporations reporting in the various groups covered.

The low level of the proportion of net income to total assets in mining and quarrying compared with total manufacturing and construction during the latter half of the twenties is a striking feature of figure 14. When industries engaged in manufacturing were enjoying average returns on income to total assets of from 5 to 7 percent, and those in construction were getting 3.5 to 6.5 percent, concerns engaged in mining and quarrying were averaging from −0.6 to only a little better than 2 percent.

In the matter of cash-dividend payments to total assets, mining and quarrying concerns have a somewhat better record when compared with those engaged in manufacturing and construction; but even here the showing is none too favorable.

NEW SECURITIES REGISTERED

Considerable information concerning new securities offered for sale by mineral extractive and related industries is now available from reports of the Securities and Exchange Commission. Details of new security offerings registered with the Commission by these industries and by all manufacturing industries (for purposes of comparison) from October 1, 1934, to June 30, 1935, and from July 1, 1935, to June 30, 1936, are given in the accompanying table:

Statistics of new securities fully effective under the Securities Act of 1933 registered by the Securities and Exchange Commission for mineral extractive industries, associated industries, and all manufacturing industries, Oct. 1, 1934, to June 30, 1935, and July 1, 1935, to June 30, 1936 [1]

[All figures in thousands, except first column, which shows the actual number of issues]

	Number of issues	Total amount registered	Total securities proposed to be offered for sale	Total selling and distributing expenses	Net proceeds less cost of selling and distributing	Net proceeds of securities offered for sale to be used for—					
						Organization and development	Purchase of—		Increase of working capital	Retirement of preferred stock	Repayment of indebtedness, total
							Plant and equipment	Total all assets			
Oct. 1, 1934–June 30, 1935											
Extractive industries:											
Metal mining	30	$15, 422	$6, 685	$1, 885	$4, 799	$1, 381	$2, 112	$2, 176	$994		$219
Oil and gas wells	19	8, 330	4, 483	873	3, 609	420	1, 894	2, 221	743		50
Total extractive	49	23, 752	11, 168	2, 758	8, 408	1, 801	4, 006	4, 397	1, 737		269
Associated industries: [2]											
Mineral oil refining	7	20, 056	14, 543	599	13, 944		627	669	98		13, 177
Iron and steel	3	93, 625	75, 250	2, 572	72, 678		12, 558	12, 558	1, 729		58, 391
Nonferrous metals	2	8, 300	5, 000	325	4, 675				2, 338		2, 338
Total associated	12	121, 981	94, 793	3, 496	91, 297		13, 185	13, 227	4, 165		73, 906
Total extractive and associated industries	61	145, 733	105, 961	6, 254	99, 705	1, 801	17, 191	17, 624	5, 902		74, 175
Total manufacturing industries	60	212, 503	175, 902	6, 700	169, 202	86	16, 160	16, 811	18, 989		133, 293
July 1, 1935–June 30, 1936											
Extractive industries:											
Coal mining	6	15, 622	3, 146	149	2, 997	159	291	291	776	$1, 606	166
Metal mining	60	51, 267	41, 541	9, 203	32, 338	5, 031	4, 978	6, 569	3, 622		17, 116
Oil and gas wells	32	26, 522	20, 543	5, 171	15, 372	2, 877	3, 025	4, 373	5, 987		2, 135
Quarry and nonmetal mining	3	5, 667	5, 667	279	5, 389		261	261		310	4, 818
Total extractive	101	99, 078	70, 897	14, 802	56, 096	8, 067	8, 555	11, 494	10, 385	1, 916	24, 235
Associated industries: [2]											
Mineral oil refining (including distribution)	19	433, 897	370, 337	8, 008	362, 329		2, 163	2, 163	29, 664	82, 445	248, 056
Iron and steel (excluding machinery)	37	470, 908	345, 312	12, 490	332, 822	5	43, 557	44, 261	14, 577	8, 603	264, 918
Nonferrous metals	15	71, 565	68, 799	2, 751	66, 048	90	1, 404	1, 417	1, 366	1, 103	62, 072
Total associated	71	976, 370	784, 448	23, 249	761, 199	95	47, 124	47, 841	45, 607	92, 151	575, 046
Total extractive and associated industries	172	1, 075, 448	855, 345	38, 051	817, 295	8, 162	55, 679	59, 335	55, 992	94, 067	599, 281
Total manufacturing industries	339	1, 617, 946	1, 194, 430	42, 134	1, 152, 296	1, 156	80, 113	82, 805	98, 445	124, 807	844, 423

[1] First and second Annual Reports of the Securities and Exchange Commission.

[2] Included under manufacturing industries in S. E. C. tabulation and therefore in the total manufacturing listed herewith.

Perhaps the most striking feature shown by the figures is the huge increase in securities registered in the fiscal year 1936 compared with the last 9 months of the previous fiscal year. Of the mineral extractive industries, those engaged in metal mining have been by far the most active in offering new securities for sale. The principal intended use of the proceeds for the period October 1, 1934, to June 30, 1935, was for the purchase of plant and equipment, while in the fiscal year 1936 the principal intended use of the greatly enlarged proceeds was for repayment of indebtedness, although a considerable portion was also to be used for organization and development, purchase of plant and equipment, and increase of working capital. Of the industries closely associated with mineral extraction (many of them doubtless engaged in this type of operation in addition to manufacturing products therefrom), those engaged in iron and steel manufacturing offered the largest amount of new securities for registration, closely followed by petroleum refining companies. The principal intended use of the net proceeds by both these industrial groups was for repayment of indebtedness, although sizable amounts were intended for purchase of plant and equipment by the iron and steel industry in the fiscal year 1936.

Another point worthy of note is the dominant position of manufacturing industries associated with mineral extraction in the entire field of manufacturing, in regard to total securities registered. In the 9 months ended June 30, 1935, associated industries engaged in manufacturing registered 57 percent of the securities registered by all manufacturing concerns, and in the fiscal year 1936 the proportion increased to 60 percent.

From the time the Commission was created up to December 1936, mineral extractive industries were required to use the one general registration form applicable to all industries. Inadequacies in the form for handling special problems of mine financing were soon apparent; recognizing that better work could be done for both the mining industry and the investor, a new registration form was developed (form A–O–1), which was designed particularly for the problems inherent in financing gold and silver mines in the promotional stage, since the great preponderance of mine financing dealt with by the Commission concerned this type of enterprise. The new form became effective December 23, 1936. An explanation of the problems of the Commission in dealing with mine securities was presented by its then chairman, James M. Landis, at the Metal Mining Convention of the Western Division, American Mining Congress, Denver, Colo., October 1, 1936.[12]

GOVERNMENT MINING LOANS

Information received through the courtesy of the Reconstruction Finance Corporation indicates that from February 2, 1932, to May 21, 1937, inclusive, $10,657,500 in loans has been authorized for use in mining, milling, and smelting enterprises. Of this amount, $5,812,000 has been canceled or withdrawn, $2,543,000 has not yet been disbursed, $2,302,500 has been disbursed, and $657,694 has been repaid. Details on amounts loaned for development and other purposes are shown in the following table:

[12] Landis, James M., Mine Financing as Viewed by Securities and Exchange Commission: Min. Cong. Jour., December 1936, pp. 11–13.

Loans made by the Reconstruction Finance Corporation to mining, milling, and smelting industries during the period Feb. 2, 1932, to May 21, 1937, inclusive

	Number	Institutions	Amount authorized	Withdrawals and cancellations	Proceeds not yet disbursed	Proceeds disbursed	Repayments	Proceeds disbursed less repayments
Development	76	73	$1,272,500	$261,000	$558,000	$453,500	$22,694	$430,806
Other	42	37	9,385,000	5,551,000	1,985,000	1,849,000	635,000	1,214,000
	118	110	10,657,500	5,812,000	2,543,000	2,302,500	657,694	1,644,806

From February 2, 1932, through May 22, 1937, the Corporation has also authorized loans to 28 coal companies amounting to $6,250,976, of which $2,504,992 has been withdrawn or canceled, $2,484,515 disbursed, and $141,655 repaid.

No loans have been authorized to firms or individuals engaged in petroleum production.

Further details concerning mining and other loans made by the Corporation may be found in its monthly and quarterly reports sent to Congress and available in printed form.

RESERVES

Early in 1936 a report [13] was released by the National Resources Committee, which summarized available information on reserves of 31 important minerals in the United States. The following excerpt from the foreword, pages 1 and 2, is a concise statement of the situation for important minerals as viewed by the authors:

Coal is perhaps our most abundant mineral resource. Beds now known, which can be mined under present conditions, have reserves sufficient to last 4,000 years. Iron ore, limestone, gypsum, aluminum, and molybdenum are also materials which will last far beyond any period for which we should feel concern. On the other hand, there are several minerals whose reserve life can only be measured by the decades, and in the cases of these very few decades will elapse before their exhaustion. Oil will last, at its present rate of consumption, for some 40 years, but changing economic needs and processes will alter the rate of use and consequently change the period of its depletion.

The reserves of lead, gold, and silver may last for a few decades only; lead and silver could, conceivably, be depleted in only 20 years. Copper, zinc, and fluorspar will probably last longer than lead and silver, but the period before their exhaustion will also be comparatively short. Many of the nonmetallics, such as china clay, graphite, mica, asbestos, and magnesite, exist in very large tonnages but, because of economic reasons or trade preferences, fail to capture the entire domestic market. Some of the conditions that have so far limited the production from this group of deposits will undoubtedly change in the future, and present unused deposits will be exploited. For another group of minerals the supply is already deficient; for some, such as nickel and tin, virtually nonexistent. The deficient list includes manganese, supplies of which are very small; chromite, which is in about an equal position; vanadium, known domestic reserves of which would supply the demand of this country for less than five years; mercury, which is the most erratic of metals and whose reserves are known to be small; and tungsten. These minerals are all necessities and our dependence upon foreign supplies either now or in the very near future must be recognized.

Discussion in much greater detail of reserves of individual minerals is given in the separate chapters through the report. An important factor to bear in mind is the approximate price level, which was considered in making the estimates for each mineral, as variable prices may change the availability of reserves in very large amounts.

[13] Leith, Kenneth, and Liddell, Donald M., The Mineral Reserves of the United States and Its Capacity for Production: National Resources Committee, Washington, D. C., March 1936.

153336—37——3

Many students of problems of mineral reserves may not agree with some of the conclusions stated in the report; however, it must be borne in mind that such a broad study necessarily was based largely on facts available in technical and business literature, supplemented by personal experience, correspondence, and information supplied by technical bureaus of the Government. Undoubtedly much pertinent information concerning the problem is available only to private individuals or companies, and it would indeed be a national benefit if more such data were made available.

In recent years considerable discussion has arisen concerning the possibility of exploiting low-grade mineral deposits, particularly those of which the United States has insufficient supplies for normal requirements, by means of the cheap power now available at Boulder Dam. During 1936 a Government report [14] presented details concerning mineral supplies in this area. Summarized findings of the investigators as given on pages 4 and 5 are as follows:

This inquiry indicates that the region under consideration contains an uncommonly wide range of commercially valuable minerals and that some are present in great quantity of good grades and in part readily accessible by truck or railroad transportation to the area near the dam.

An appraisal of the resources may be expressed as follows:

A. Minerals or ores that have been found to be present in large quantity, of good or excellent quality, and readily accessible to transportation:

1. Nonferrous-metal ores: Lead-zinc or lead and zinc, Pioche, Yellow Pine (Goodsprings), Comet, Nev., and Wallapai, Ariz.; copper, Jerome, Ariz.
2. Ferrous-metal ores: Iron, Iron Springs (Desert Mound), Utah, and Baxter (Cave Canyon), Calif.; tungsten, Atolia, Calif., and Boriana, Ariz.
3. Nonmetallic minerals: Limestone, dolomite, gypsum, borates, celestite, salines (sodium chloride, sodium sulphate, sodium carbonate, potassium bromide, potassium chloride, calcium chloride), bleaching clays, refractory silica, and alunite.

B. Minerals or metals which have been found to be present in large quantity near a railroad but of a grade below that commonly considered acceptable and which may require new or uncommon methods of treatment before they can be marketed.

1. Nonferrous-metal ores: None.
2. Ferrous-metal ores: Manganese, Las Vegas (Three Kids), Nev.
3. Nonmetallic minerals: Magnesite, Muddy Mountains, Nev.; coal, Colob-Kanab field, Utah.

C. Minerals or metals which have been found to be present in large quantity and of good or excellent quality but which are remote from railroads that would insure cheap transportation to the dam area:

1. Nonferrous-metal ores: Eureka district, Arizona.
2. Ferrous-metal ores: Iron, Eagle Mountains, Kingston Mountains, San Bernardino County, Calif.; manganese, Artillery Peak, Mohave County, Ariz.
3. Nonmetallic minerals: Magnesite and brucite, Paradise Range, Nye County, Nev.

There are many districts in this region that contain noteworthy deposits of metals and nonmetallic minerals, some of which have already yielded a large production but will probably not contribute raw materials to industries near the dam. Included in this group would be numerous mines and districts whose principal product is gold or silver. Some of these, or groups of them, may when operated become potential consumers of power transported by trunk lines from Boulder Dam, but on the whole it is believed that the number will be small. These districts or groups of districts will reveal themselves by careful study of all the factors that determine success in operating mines. It is believed that the chief hope for markets for Boulder Dam power arising out of mining activities will lie in manufacturing industries located near the dam and using nearby mineral raw materials.

[14] Mineral Resources of the Region Around Boulder Dam: U. S. Geol. Surv. Bull. 871, 1936.

LEGISLATION, INVESTIGATIONS, AND COURT DECISIONS AFFECTING THE MINERAL INDUSTRY

Legislation directly concerned with the mineral industry in 1936 centered around the attempt to pass the Bituminous Coal Act of 1936 (the so-called Guffey Act) in the closing days of the second session of the seventy-fourth Congress, following the decision of the United States Supreme Court in the *Carter Coal case* on May 18, 1936, that the Bituminous Coal Conservation Act of 1935 was unconstitutional. The 1936 Act (S. 4668 and H. R. 12800) was substantially a redraft of the act of 1935, with the labor regulations deleted from the bill, according to the view of the majority of the Court. Four of the Justices, including the Chief Justice, had held that the provisions of the code could be, and were intended to be, regarded as separable from the labor-control provisions and that the price-fixing provisions were a valid exercise of the authority of Congress under its power over interstate commerce. The 1936 act (H. R. 12800) was passed by the House on June 16, 1936, and was debated in the Senate. A filibuster by Senator Holt of West Virginia on the final day of the session, June 20, prevented action on the bill in the Senate.

Essentially the same bill came up for consideration in the first session of the seventy-fifth Congress and in a slightly modified form was passed by both Houses of Congress, agreed to in conference on April 12, 1937, and signed by the President April 26, 1937. The act establishes in the Department of the Interior a National Bituminous Coal Commission composed of seven members and a consumers' counsel, imposes a tax of 1 cent per net ton on the sale or other disposal of all bituminous coal produced in the United States, sets up a bituminous-coal code prescribing minimum and maximum prices and unfair methods of competition, exempts members of the code from payment of an excise tax of 19½ percent of the sale price or fair market value of all bituminous coal sold or otherwise disposed of which was produced in the United States, and charges the Commission with other duties, including investigation of methods of increasing the uses of coal, economic operation of mines looking toward coal conservation, safe operation of mines to minimize working hazards, and problems of marketing in order to decrease distributing costs for consumers' benefits.

The Faddis-Barbour tin bill (Public Law, 448, 74th Cong.), passed by the Senate in 1935, was passed by the House February 3, 1936, and approved by the President February 15, 1936. To provide for the protection and preservation of domestic sources of tin, the law prohibits the exportation of tin-plate scrap from the United States except upon license issued by the President. On February 16, 1936, the President issued an Executive order that delegated his licensing authority under the act to the National Munitions Control Board; and on April 4, 1936, the Secretary of State issued regulations defining tin-plate scrap, prohibiting export licensing from April 16 to July 1, 1936, and presenting forms that must be filled out in applying for export licenses to be granted by the National Munitions Control Board after July 1, 1936, providing their issuance is consistent with the purposes of the act.

Other laws enacted in 1936, important to all business, including the mineral industry, included the Revenue Act of 1936, the most controversial new feature of which consisted of a graduated surtax on

undistributed net income; the Government Contract Labor Standards Act of 1936 (the Walsh-Healy Act), which required that firms contracting for sale of materials, supplies, or equipment to the Federal Government or any agency thereof in amounts exceeding $10,000 be required to comply with certain labor provisions, including minimum wages, the 40-hour week, and no child labor, the Secretary of Labor having been designated as supervising agent of the Government to administer the act; and the Anti-Price Discrimination Act of 1936 (the Robinson-Patman bill), which authorized the Federal Trade Commission to investigate and prohibit discriminations in price where they may substantially decrease competition or tend to create a monopoly in interstate commerce, and made the recipient of an illegal price discrimination equally guilty with the person who granted it.

Federal legislation under serious consideration in 1936 of vital interest to the mineral industry included two bills dealing with stream pollution; and a bill providing transfer to the States of public lands, contained therein, including minerals, subject to certain conditions.

Early in 1936 several resolutions were introduced in Congress calling for thorough investigations of health conditions in connection with mining or tunneling operations. In accordance with the one introduced by Representative Marcantonio (H. J. Res. 449), a general survey of silicosis problems was undertaken by the Secretary of Labor. Conferences were held in February and May 1936, and committees were appointed to study the medical and engineering methods of prevention and the economic, legal, and insurance aspects of silicosis. Officials of the United States Bureau of Mines and the Public Health Service presented much information in connection with these investigations.

Legislation of particular interest to the mineral industry under consideration during the first session of the Seventy-fifth Congress included, in addition to the bituminous-coal control bill already discussed, stream-pollution bills similar to those introduced in 1936, one of which (H. R. 2711) passed the House on April 21, 1937, and at the time of writing is now subject to Senate action; several bills prohibiting export of iron and steel scrap, except under license; an amendment to the Navy Department appropriation bill authorizing expenditure of $3,500,000 for the purchase of strategic minerals; and the Connally bill, continuing indefinitely Federal control of "hot oil" shipments in interstate or foreign commerce, which passed the Senate early in 1937 and was referred to the House for consideration. A live subject, still unsettled June 1, 1937, is the fate of the excise taxes on imported copper, coal, and petroleum, which expire on June 30 according to provisions of the Revenue Act of 1934.

Decisions of vital importance to all industry in the United States were handed down by the United States Supreme Court when, in April 1937, the National Labor Relations Act (Wagner Act) was upheld, and in May 1937 the Social Security Act was also declared constitutional.

FOREIGN TRADE

Foreign trade in minerals in 1936 was featured by a continuation of the steady improvement of the 3 previous years, exports in 1936 amounting to $596,619,000 compared with $535,607,000 in 1935, a gain of about 11 percent. Imports increased more sharply, from $280,992,000 in 1935 to $332,217,000 in 1936, a gain of 18 percent. The gain in trade of minerals, as of all merchandise, over 1935 would have been much more marked had it not been for the shipping strike which completely paralyzed all foreign trade in merchandise on the Pacific coast from November 1, 1936, to February 3, 1937, and which interfered to a serious extent with shipping operations on the Atlantic and Gulf coasts over the same period.

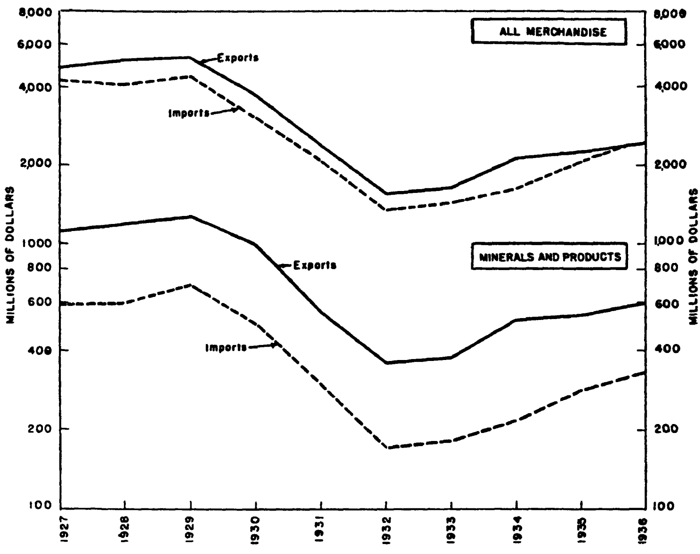


FIGURE 15.—Trends in the value of imports and exports of minerals and their products compared with all merchandise, 1927–36. Data from Bureau of Foreign and Domestic Commerce.

These figures represent the totals of group 5 (nonmetallic minerals) and group 6 (metals and manufactures, except machinery and vehicles) as compiled by the Bureau of Foreign and Domestic Commerce. Included, therefore, are semimanufactures and even advanced manufactures of both nonmetallic minerals and metals, except machinery and vehicles, so that the data by no means show United States trade in crude or raw mineral materials alone. Furthermore, a number of raw and semimanufactured minerals classified by the Bureau of Foreign and Domestic Commerce as chemicals, such as coal tar and products, borax, soda ash, carbon black, nitrate, phosphate, potash, and others, are not included. A complete retabulation of the entire import-export schedule relating to minerals and chemicals, excluding advanced manufactures and including various minerals classed as chemicals, would be necessary to depict the exact situation. The total value figures presented should be understood, therefore, as merely indicating broad trends.

The following principal commodities comprised about 83 percent of the value of our exports of minerals and products in 1936:

	Value	Percent of total value
Petroleum and products	$260, 800, 000	43. 7
Anthracite and bituminous coal	52, 400, 000	8. 8
Refined copper (mainly of foreign origin)	40, 700, 000	6. 8
Iron and steel advanced manufactures	37, 900, 000	6. 3
Steel mill manufactures	32, 000, 000	5. 4
Tin plate	23, 500, 000	3. 9
Iron and steel scrap	21, 800, 000	3. 7
Steel sheets	14, 500, 000	2. 4
Crude sulphur	10, 100, 000	1. 7
Undistributed	102, 900, 000	17. 3
Total minerals	596, 600, 000	100. 0

In the petroleum and products group, refined oils constituted the principal value at $176,700,000, with crude oil at $66,100,000; and of the refined oils, lubricating oil was the largest item, ahead of gasoline. Exports of bituminous coal ($38,600,000) were considerably more important than those of anthracite ($13,800,000). Exports of refined copper consist very largely of blister imported in bond for refining and export; since its form is changed in the United States, it is classed as a domestic export even though it is dominantly of foreign origin. The important position of iron and steel, including semimanufactures, steel-mill manufactures, and advanced manufactures, in our mineral export trade is shown by the table.

Increases in exports were well distributed, although outstanding examples of larger-than-average gains comprised tin plate, with an increase of 80 percent in value and 75 percent in quantity, and sulphur, with value and quantity increases of about 34 percent. Exports of refined copper (mainly of foreign origin) fell off 15 percent in quantity, with the value remaining about the same, due to higher prices.

The following principal commodities comprised 75 percent of the value of our imports of minerals and products in 1936:

	Value	Percent of total value
Tin	$75, 500, 000	23. 0
Petroleum and products	40, 200, 000	12. 0
Diamonds	33, 300, 000	10. 0
Copper (mainly in bond for refining and export)	29, 900, 000	9. 0
Nickel	23, 800, 000	7. 0
Ferro-alloys	20, 600, 000	6. 0
Steel-mill manufactures	13, 100, 000	4. 0
Iron and steel semimanufactures	8, 400, 000	2. 5
Iron ore	5, 300, 000	1. 5
Undistributed	82, 100, 000	25. 0
Total minerals	332, 200, 000	100. 0

Of the total copper shown under imports in 1936, 88.5 percent of the value and 87 percent of the quantity consisted of copper in the form of ore, matte, or blister (mainly blister), which was imported in bond for refining and export. Only minor amounts actually enter the United States for consumption over the 4-cent-per-pound excise tax on imports. Of petroleum and products imported in 1936, about 54 percent of the value consisted of crude oil and about 41 percent of advanced and refined oils. Cut but unset diamonds comprised 68 percent of the value of all diamonds imported in 1936. Of the ferro-

alloys, manganese ore and ferromanganese constituted more than half and chrome about 21 percent of the total value.

Import gains likewise were well distributed, although better than average increases were shown by the following commodities: Abrasives increased 28 percent in value; asbestos and manufactures, 47 percent; cut but unset diamonds, 46 percent; ferro-alloys, 63 percent; and nickel, 39 percent. Imports of copper in bond for refining and export decreased 14 percent in value and 28 percent in quantity in 1936 compared with 1935.

For the first time since 1893 the value of all merchandise imported into the United States was greater than that exported. This doubtless indicates greatly improved industrial conditions in the United States, coupled with the drought, tending to increase imports more rapidly than exports, which are still hampered by nationalistic policies, exchange control barriers, and other discriminatory trade measures in many world markets of great importance in our earlier foreign trade.

Another factor of great importance in improving United States foreign trade has been the reciprocal trade agreements program. Fifteen agreements had been concluded up to December 31, 1936, all of which were in effect at that time. Ten of the agreements became effective during 1936.

IMPORTANT FOREIGN DEVELOPMENTS AFFECTING MINERALS

The outstanding foreign development of 1936 affecting minerals was the competition in world rearmament prompted by increasing fears of a general outbreak of hostilities between important world powers. Incidents arising from the application and attempted enforcement of sanctions against Italy at times increased this tension. This source of friction was removed by withdrawal of sanctions in July 1936, following Italian victories in Ethiopia; but other serious troubles soon arose in the form of the Spanish rebellion and the demands of Germany and Italy for a more equitable share of world raw materials to ease the serious condition of their domestic economy. The swift rearmament race of the past year or two was culminated early in 1937 by the announcement by Great Britain of a vast rearmament program involving the expenditure of approximately £1,500,000,000 in the next 5 years. The effect on industrial recovery of these huge armament expenditures, which, according to a German estimate dispatched to the New York Times,[15] accounted for 11 percent of the world's industrial production in 1936 compared with only 4 percent during the war and during the 1920's, has been most profound. Great advances in mechanization of military and naval operations during the past two decades have increased the importance of minerals in such operations and hence in a preparedness program. The use of metals for these purposes was just making itself felt in 1936 in world-consumption statistics, and 1937 should certainly offer additional evidence of the influence this factor exerts in any present-day analysis of the consumption of mineral commodities.

During 1936 the position of the gold-bloc countries became steadily worse, until, on September 25, an announcement was made by the

[15] Case, Winthrop W., World Recovery Goes Forward Despite Trend Toward Economic Nationalism: Annalist, Jan. 22, 1937, p. 131.

United States Treasury that an agreement had been reached between the Governments of Great Britain, France, and the United States as to a policy for maintaining the greatest possible equilibrium in the system of international exchange and by relaxing progressively the present system of quotas and exchange controls with a view to their ultimate abandonment. Shortly after this, and as a result thereof, action by France, Switzerland, the Netherlands, and Italy in devaluing their currencies brought back their exchange rates roughly to the levels in relation to the dollar and sterling that prevailed before the abandonment of the gold standard by Great Britain in 1931. This was an important step toward a much more general revival of international trade.

Cartels.—International control agreements (cartels) of one kind or another continued to operate in production of tin, copper, aluminum, cobalt, magnesite, and potash.

The restriction agreement covering tin was due to expire at the end of 1936. Negotiations to renew the agreement were undertaken during the year, and finally, on January 5, 1937, official announcement was made that a new plan had been accepted by all countries signatory to the original agreement, to be effective for 5 years starting January 1, 1937.

The copper curtailment agreement, made in 1935, continued in effective operation in 1936, the parties thereto being the large producers in Chile, Belgian Congo, and Rhodesia. Up until August the rate of production continued at 70 percent of the original agreed capacity. Successive increases in production quotas were made until, at the close of 1936, the rate was 105 percent of "capacity" fixed by the original agreement. Early in 1937 all restrictions were removed when the copper market developed runaway tendencies, but reports in May indicate that attempts are being made to renew restriction.

Efforts were made during 1936 to renew the zinc cartel, which had terminated in 1934, but difficulties resulting from nationalistic programs aimed at self-sufficiency were too great and results were negative.

The quicksilver cartel was terminated in December 1936, presumably because of the tense feeling between Spanish loyalists, still in control of the Almaden mine, and the Italians.

PROGRESS IN MINE MECHANIZATION

By O. E. Kiessling, F. G. Tryon, L. N. Plein, and F. E. Berquist [1]

SUMMARY OUTLINE

MINERAL-TECHNOLOGY AND OUTPUT-PER-MAN STUDIES

By O. E. Kiessling and F. G. Tryon [1]

Among the complex factors that have contributed to the economic advance of the United States during the last half century, few have been more important than the ability of the mining industry to provide an increasing abundance of raw materials of the underearth at declining cost. More than 50 years have now elapsed since the creation of the United States Geological Survey in 1879 set in motion an inventory of the national resources of minerals and a systematic record of their utilization. The period since then has been marked by many changes, particularly by the discovery of new deposits. Although the golden age of surface prospecting for the metals has now drawn to a close and the day of the old-time prospector seems nearly over, new methods of applying geology and physics to the task of exploration continue to yield discoveries of minerals, particularly petroleum and natural gas, and may in time add greatly to the Nation's store of metal as well.

Evidence of increasing depletion.—The period since 1879 has also been marked by progressive depletion, which in some branches has

[1] This report by members of the Bureau of Mines staff was made possible by the cooperative arrangement between the Bureau of Mines and the Works Progress Administration's National Research Project on Reemployment Opportunities and Recent Changes in Industrial Techniques. Results of this cooperative effort are reviewed both by Bureau officials and by David Weintraub and Irving Kaplan, respectively Director and Associate Director of the National Research Project, WPA.

largely offset the contributions of mineral discovery. Many once-famous metal camps have reached an old age that even $35 gold cannot rejuvenate. Other districts that still rank as major producers show clearly the handicaps of depletion. Gold mines on the Mother Lode are down to 5,300 feet. Butte has touched a depth of 4,100 feet. Magma at 3,600 feet and the Morning mine at 5,400 feet are in districts where increasing depth is a factor to be reckoned with. Michigan, earliest among the great copper districts, has reached depths of 6,200 feet, quite the deepest levels at which men have tried to win the base metals anywhere in the world. Meantime the average grade of ore mined has declined. The average yield of mercury per ton of ore has dropped from 2.92 percent (New Almaden mine) in 1880 to 0.30 percent in 1929. The average yield of copper has fallen from about 60.2 pounds per ton of ore in 1880 (68.4 pounds in 1889, when Montana began to assume a more important place in production) to 28.2 pounds in 1929.[2] In oil and gas the brilliant discoveries of new fields in the Southwest and California mask the impending exhaustion of many hundred old ones, and even in the bituminous-coal fields there are districts in which the finest seams are nearing exhaustion. In anthracite mining, 29 percent of the reserves are exhausted; from 1872 to 1935 the average depth of workings has doubled, and the average thickness of the beds mined has been cut in half.[3] In addition, the problem of mine drainage has so increased that today 33 tons of water must be pumped from the mines for every ton of anthracite raised from underground.[4]

Some day depletion is likely to force a general increase in mining costs and in the price of mineral products. But thus far, with some exceptions, mineral technology has succeeded in offsetting the pressure of depletion and, broadly, in reducing both costs and prices. Cost comparisons in dollars and cents are much affected by changes in the purchasing power of the dollar and in wage rates, but except for the munitions shortage that accompanied the World War, mineral prices have shown a long-time downward trend in relation to the all-commodity price index. In the years since 1879 the metals, especially, have dropped many points in comparison with the general level of prices.[5]

Large gains in efficiency.—This decline of mineral prices in the face of the growing handicaps of depletion has been made possible by great advances in efficiency. The changes are best measured in the output per man. In iron-ore mining, productivity per man increased from 234 tons in 1880 to 2,560 in 1929. In coal mining—anthracite and bituminous—the increase was from 422 to 930 tons; in copper mining, from 9,290 to 44,900 pounds of metal; and in the production of phosphate rock, from 90 to 1,206 tons.[6] In several branches of mining, the increasing output per worker has been especially rapid in the period since the war. For the minerals as a group, however, the rate of increase has often fallen short of that in manufactured goods.

[2] Corry, A. V., Trends in Grade of Ore: WPA National Research Project (in preparation).

[3] Ashmead, D. C., Factors Influencing the Cost of Mining and Productivity of Employees in the Anthracite Region of Pennsylvania: WPA National Research Project (in preparation).

[4] Ashmead, D. C., Water Pumped From the Mines of the Anthracite Region of Northwestern Pennsylvania: Trans. Am. Geophys. Union, 1937.

[5] Tryon, F. G., Read, T. T., Heald, K. C., Rice, G. S., and Bowles, Oliver, Technology and the Mineral Industries: Rept. E-1, Mineral-Technology and Output-Per-Man Studies, National Research Project, WPA, in cooperation with the U. S. Bureau of Mines, Philadelphia, Pa., April 1937, chart 2.

[6] Tryon, F. G., Read, T. T., Heald, K. C., Rice, G. S., and Bowles, Oliver, work cited (footnote 5), chart 3.

The advance of mineral technology is a subject of deepest interest to the Bureau of Mines and to practical mining men.[7] Next to the primary records of production and demand, the most important barometers of change in the mining industry are the trends in the use of manpower and in underground methods and equipment. For this reason the Economics Branch of the Bureau is seeking to develop adequate records of the labor force required in mining, of the man-hours expended per ton of product, installed horsepower, power consumed, tonnages produced by various mining systems, and mechanical equipment.

Mechanization progress studied by WPA.—A beginning has been made in the analysis of these factors, particularly in coal mining. When, therefore, the Bureau was asked by David Weintraub, Director, National Research Project of the Works Progress Administration, to cooperate in a study of reemployment opportunities and recent changes in industrial techniques, the invitation could hardly be declined. The cooperation of the Works Progress Administration has enabled the Bureau to supplement its own resources of data and to recruit enough workers to review systematically the trends of output per man in the light of changing technology. Preliminary reports on certain phases of the inquiry have already been made.[8] Detailed studies tracing the changes in output per worker, mechanical equipment, and mining methods are in process that will cover anthracite and bituminous coal, petroleum and natural gas, iron, copper, lead and zinc, phosphate rock, crushed stone, and certan other mineral industries.

In many branches of mining, it is found that progress in underground technology has centered largely in the art of handling ground, the peculiar province of the mining engineer. This is illustrated by the shrinkage or caving methods developed to work massive ore bodies, such as the low-grade porphyry coppers.

But along with these methods have come remarkable advances in the mechanization of tasks formerly done by hand. Improvements in mechanical equipment have characterized all departments of mining; but in the period since the war the outstanding development in mechanization below ground has been the replacement of hand shoveling by scrapers or power shovels. Any account of mining technology and its effects on requirements of manpower during the postwar years is therefore largely concerned with the application of mechanical loading.

Two ways of measuring advances in the use of machinery present themselves. The first is to ask mine operators to report the number and type of machines in use and the tonnage handled therewith. Operating records for certain kinds of machinery in the coal mines have been kept since 1891. Coal-cutting machines were introduced in the eighties. From 5 percent in 1891, the year of the first survey, the proportion of the national output of bituminous coal cut by machine has increased to 84 percent in 1935, a proportion now close to the saturation point, though improvements in the speed and efficiency of the machines are expected to continue. The improvement

[7] The lively interest in this field is indicated by the expositions held periodically by the American Mining Congress, at which manufacturers of mining equipment display their newest wares to literally thousands of coal- and metal-mine operators.

[8] Tryon, F. G., Read, T. T., Heald, K. C., Rice, G. S., and Bowles, Oliver, work cited (footnote 5); also, Merrill, C. W., Henderson, Chas. W., and Kiessling, O. E., Small-Scale Placer Mines as a Source of Livelihood in 1935, Rept. E-2, Mineral-Technology and Output-Per-Man Study, National Research Project, WPA, in cooperation with the U. S. Bureau of Mines, Philadelphia, Pa., May 1937.

in performance attained meanwhile is indicated by the increase in daily tonnage per machine from 51 in 1891 to 136 in 1935.

Thirty years later mechanical loaders first entered the field. The initial systematic record of numbers of loading machines used was reported by the coal-mine operators to the Bureau of Mines in 1923. At that time the tonnage of bituminous coal loaded mechanically was found to be 1,879,000 tons, reported by 60 mines. From this level the tonnage mechanically loaded increased to 47,177,000 tons, produced by 317 mines in 1935.

Recording mechanical equipment as a feature of the annual statistics of mine operation has proved of wide interest to the coal industry, and the Bureau plans to extend it to metal mining and the production of the nonmetals as well. However building up complete records from the operating side requires many months of correspondence and field work because of the great number of mines to be covered and the necessity of accounting for all before the inventory of equipment can be deemed complete. With 6,300 producing units to be canvassed in the bituminous-coal industry alone, plus several thousand metal mines, large and small, and other thousands of nonmetallic operations, a direct census of mines and quarries necessarily consumes months or years.

Manufacturers' reports as index of trends.—Fortunately, there is an alternative way to ascertain quickly the outstanding changes in mechanization—to draw upon the experience of equipment manufacturers. Twenty-eight manufacturers produce 99 percent or more of the loading equipment supplied to coal mines in the United States, and even fewer fill the needs of the metal mines and quarries for such equipment. If manufacturers are disposed to cooperate and appreciate the importance of such records, a bird's-eye view of the change in mechanical equipment can be obtained easily and quickly. Where the census of mines themselves takes many months, a summary of manufacturers' shipments can be completed soon after the new year.

The two papers that follow illustrate the possibilities of such manufacturers' reports as an index of the advance in mining practice. The first, dealing with mechanical loading in coal mines down to the end of 1936, was completed and published on February 10, 1937. The second, which deals with metal mines, covered a wholly uncharted field; yet here a substantially complete count down to the end of 1936 was in print by May 15. The preliminary articles, made available to the mining industry by courtesy of The Mining Congress Journal [9] and the Engineering and Mining Journal,[10] are here given in more detail.

Records of manufacturers' shipments are not a substitute for operating records of machine performance, but the two supplement each other usefully. With the help of the mining companies that furnish information on production, the Bureau will spare no effort to develop for all branches of mining adequate records of machine equipment, man-hours and kilowatt power-hours per ton, as well as additional information on operating performance. Reports of manufacturers' shipments improve the accuracy of this work and permit early determination of trends. It is hoped that the following surveys can

---

[9] Plein, L. N., and Tryon, F. G., sales of Mechanical Loading and Cleaning Equipment for Use in Coal Mines in 1936: Min. Cong. Jour., February 1937, pp. 57–60.

[10] Plein, L. N., Berquist, F. E., and Tryon, F. G., Mechanical Loading Underground—a New Survey: Eng. and Min. Jour., vol. 138, no. 5, 1937, p. 241.

be continued in the future, maintaining an up-to-date indicator of technical progress.

MECHANICAL LOADING IN COAL MINES

By L. N. Plein and F. G. Tryon

Total units sold in 1936.—A substantial increase in the use of mechanical loading devices in both anthracite and bituminous-coal mines is indicated by manufacturers' shipments in 1936.

Reports courteously furnished by 28 manufacturers are summarized in the following table. Sales of mobile loaders reached a total of 344 units, nearly treble the figure for 1935 and larger than that reported in any previous year. Sales of conveyors were reported as 972 units, an increase of 47 percent over the year preceding. Sales of scrapers or scraper hoists increased 27.3 percent. Sales of pit-car loaders, on the other hand, were less than in the year before.

Units of mechanized loading equipment sold to anthracite and bituminous-coal mines, as reported by identical manufacturers, 1933 to 1936, inclusive

	1933	1934	1935	1936	Percent increase (+) or decrease (−), 1936 over 1935
Mobile loaders	41	55	115	344	+199.1
Scrapers	65	34	22	28	+27.3
Conveyors [1]	384	596	661	972	+47.0
Pit-car loaders	18	26	28	11	−60.7

[1] Includes hand-loaded conveyors and conveyors equipped with duckbills and other self-loading heads.

Total sales, by States.—Shipments of mechanized loading devices of one type or another were made to 19 States in 1936. Nearly every important producing State is represented in the list. In many of the smaller States it is impossible to show the number of machines of each type sold without disclosing the business of individual manufacturers. However, the total number of units shipped to each State or region during the year is listed below. The kinds of machines sold are indicated in a parallel column, the abbreviation L standing for mobile loaders, S for scrapers, P for pit-car loaders, and C for all types of conveyors, including those equipped with loading heads. The several types are arranged in the rough order of their capacity. Thus, for Ohio a total of 72 units is shown, followed by the letters L, C, and P, indicating that the highest capacity was in the form of mobile loaders, followed by conveyors and pit-car loaders.

Total number of units of mechanized loading equipment shipped for use in each State or region in 1936

[L=mobile loading machines; P=pit-car loaders; S=scrapers; C=conveyors, including those with duckbills]

	Number of units of all types shipped in 1936	Types of equipment in approximate order of capacity
BITUMINOUS COAL		
Northern Appalachian States:		
Pennsylvania—western	93	L. C.
Pennsylvania—central, and Maryland	53	C, L, S, P.
Ohio	72	L, C, P.
Southern Appalachian States:		
West Virginia—northern	87	L, C.
West Virginia—southern	258	L, C, S.
Virginia	41	C, L, S.
Eastern Kentucky [1]	41	L, C.
Alabama and Tennessee	71	C, S, L, P.
Middle Western States:		
Illinois	98	L, C.
Indiana	38	L, C, P.
Trans-Mississippi States:		
Arkansas, Iowa, and Oklahoma	39	C, S.
Colorado and New Mexico	71	C, L.
Montana and Washington	10	L, P, C.
Utah	12	L, C.
Wyoming	48	C, L.
Total bituminous	1,032	L, C, S, P.
ANTHRACITE		
Pennsylvania	323	C, S, P.
Grand total	1,355	L, C, S, P.

[1] Includes a few units in western Kentucky.

Installations versus replacements.—A point of much interest is the extent to which sales of equipment represent replacement of old machines, as opposed to new installations. The information collected did not separate replacements accurately, but some light is thrown on the question by classifying the purchasing companies into those that had made use of equipment of the type sold during the preceding year and those that had not. This is done in the following tabulation. Thus, it was found that a total of 101 bituminous-coal-mining companies had received shipments of mobile loaders in 1936. Of these, 39 companies had made use of mobile loaders during 1935. There were, however, 62 other companies buying mobile loaders in 1936 that used none in 1935. The separation is not clear-cut, since numerous mining companies that used mobile loaders in 1935 bought more machines in 1936. On the other hand, there were doubtless mines that purchased machines in 1936 to replace loaders bought some years ago and not used in 1935. The table, however, is sufficient to indicate that the bulk of shipments in 1936 undoubtedly represented additions rather than replacements.

A similar conclusion is indicated by the record of shipments of conveyors.

Number of bituminous-coal-mining companies purchasing new mechanized loading equipment in 1936 [1]

	Buying mobile loaders		Buying conveyors [2]	
	Companies that *used* mobile loaders in 1935	Companies that *did not use* mobile loaders in 1935	Companies that *used* conveyors in 1935	Companies that *did not use* conveyors in 1935
Northern Appalachian States:				
Pennsylvania and Maryland	3	15	6	10
Ohio			----------	12
Southern Appalachian States:				
West Virginia and Virginia	5	30	14	29
Kentucky	2	6	4	14
Alabama				
Tennessee	----------	----------		
Middle Western States:				
Illinois	13	11	2	2
Indiana	7			
Trans-Mississippi States:				
Arkansas, Colorado, Iowa, New Mexico, Oklahoma, Utah, Washington, and Wyoming	9	----------	9	20
Total bituminous	39	62	35	87

[1] In addition, 8 companies bought scrapers, of whom 3 used scrapers in 1935 and 5 did not. Also, 5 companies bought pit-car loaders, of which 2 used pit-car loaders in 1935 and 5 did not.
[2] Includes conveyors equipped with duckbills and other self-loading heads, and hand-loaded conveyors other than pit-car loaders.

Units shipped compared with units in use.—The changing demand for the several major types of equipment is indicated by the following table comparing the number of units in use from 1928 to 1935, inclusive, with new shipments in 1936. The number of mobile loaders in active use, as reported by bituminous mine operators, increased from 397 in 1928 to 657 in 1935. The shipment of 344 mobile loaders during 1936 was thus equivalent to more than half the total number previously in use. The shipment of conveyors in 1936 likewise constituted a large fraction of the number previously installed, as reported by the operators, especially in the bituminous fields. Because of uncertainties in definition of what constitutes a conveyor, the record of sales is not wholly comparable with the record of the number previously in use, but the fact of a large increase is clear. The number of scrapers sold, despite the increase over 1935 sales, was comparatively small compared with the numbers previously used. In the bituminous fields, the number of scrapers in use reached a peak in 1930 and has since declined. In the anthracite fields, the number of scrapers continued to increase down to 1934, declining slightly in 1935. Installations of pit-car loaders reached a maximum in 1931 and have since declined in both the bituminous-coal and anthracite mines.

Sales of mechanized loading equipment in 1936 compared with total number of machines in active use in preceding years

	Number of machines in active use, as reported by mine operators								Number of machines sold in 1936, as reported by 28 manufacturers
	1928	1929	1930	1931	1932	1933	1934	1935	
Bituminous-coal mines:									
Mobile loading machines	397	488	545	583	548	523	534	657	344
Scrapers	130	126	150	146	128	93	119	78	19
Pit-car loaders	1,040	2,521	2,876	3,428	3,112	2,453	2,288	2,098	9
Conveyors equipped with duckbills and other self-loading heads	82	99	140	165	159	132	157	179	[2] 660
Hand-loaded conveyors:									
Number of conveyor units	(1)	(1)	(1)	(1)	(1)	525	574	670	
Number of mines at which used	119	130	142	152	136	114	114	136	[3] 116
Anthracite mines (Pennsylvania):									
Mobile loading machines	302	350	384	5	11	18	14	1	--------
Scrapers				457	479	455	517	507	9
Pit-car loaders				28	24	19	25	22	2
Conveyors equipped with duckbills and other self-loading heads	184	355	421	1	17	12	13	30	[2] 312
Hand-loaded conveyors, number of units				547	818	940	1,338	1,563	

[1] Number of units not reported in these years.
[2] Reported as "conveyors (room, face, and entry)", "shaker drives", and "duckbills." The figures of number sold in 1936 are not exactly comparable with the number in use in 1935, because of uncertainties in defining what constitutes a conveyor.
[3] Represents number of bituminous mining companies to whom conveyors were sold in 1936. Of these, 32 companies were mining with conveyors in 1935, and 84 were not.

Percent of deep-mined output mechanized.—In 1935, over the country as a whole, 13.5 percent of the underground production of bituminous coal and 21.2 of the anthracite was loaded with the aid of mechanical devices. The figures include coal handled on pit-car loaders and hand-loaded conveyors as well as with mobile loaders, scrapers, and duckbills. In the past, the geographical distribution of mechanical loading has been much affected by physical conditions and by differentials in wage rates. The areas where mechanization had advanced farthest down to the end of 1935 were the Northern Rocky Mountain States, Illinois, and Indiana, areas where seam conditions were favorable and where, during the period from 1923 to 1933, wage rates, by comparison with the southern and eastern fields, were relatively high. In 1935, 89.8 percent of the deep-mined output of Wyoming was mechanically loaded. In Montana, the proportion was 80.1 percent, in Indiana 62.5, and in Illinois 55.3. In the Appalachian States, on the other hand, the proportion mechanically loaded was much smaller, though a few companies had successfully applied mechanization there, also. In 1935, the proportion of the West Virginia output mechanically loaded was 2.1 percent and that of Kentucky 1.3 (table 25, chapter of Yearbook on Coal).

Regional distribution of mechanized capacity.—Recently, market conditions and the trend of wage rates have tended to stimulate mechanization in the Appalachian region, and a large part of the sales of equipment reported by manufacturers in 1936 went to the bituminous fields of the East and South. Figure 16 shows, in generalized form, the regional distribution of sales in relation to preexisting capacity. In this map the tonnage loaded mechanically by all devices

in 1935 is shown by the black columns. To these has been added in white a rough indication of the capacity of the equipment purchased in 1936.[11] Accurate figures of the increase in actual tonnage mechanically loaded must await the detailed reports of mine operations during the year, but meanwhile the map may suffice to indicate the areas where sales of equipment were most active.

The largest installations of mechanical loading equipment seem to have been made in West Virginia, where the monthly report of the State department of mines gives a current record of the increase in tonnage mechanically mined. During 1936, 2,353,729 tons of coal were loaded on conveyors in the State, and 6,348,920 tons were produced by mobile loaders, scrapers, and other devices eliminating hand shoveling. The total loaded with the aid of mechanical devices was thus 8,702,649 tons for the year. In 1935, the total for the State, as reported to the United States Bureau of Mines, was 2,059,322 tons.

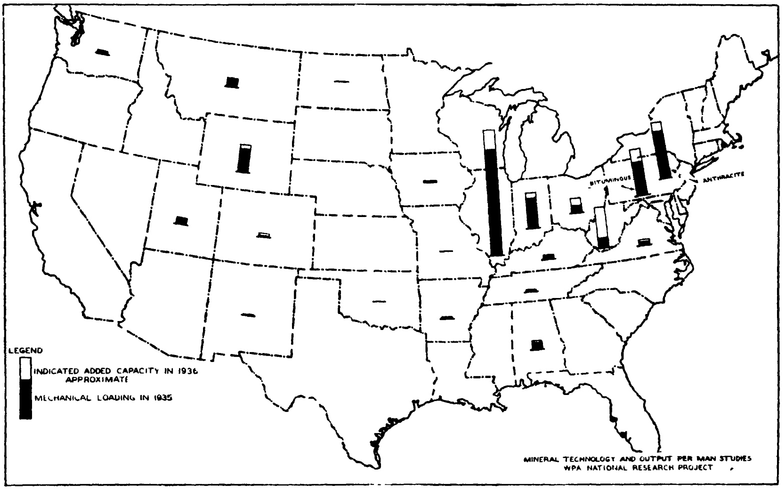


FIGURE 16.—Tonnage of coal mechanically loaded in 1935 and approximate capacity of new equipment shipped in 1936.

Black columns represent the tonnage loaded with mechanical devices, including conveyors, in 1935. Capacity of new equipment shipped in 1936 is indicated by white extensions at top of columns.

The increase indicated for West Virginia is continuing into 1937. In April 1937 the report of the State department indicated that 12.6 percent of the State output was loaded with conveyors or loaders compared with 2.1 percent as late as 1935.

The data so far available to the authors are not sufficient to permit an estimate of the total tonnage mechanically loaded in the bituminous-coal industry in 1936. Eugene McAuliffe has recently stated, "When 1936 figures are made available * * * a possible total of 60,000,000 tons may be shown." [12]

Reports to the Pennsylvania Department of Mines indicate a total of 11,019,235 tons of anthracite loaded mechanically in 1936 as against 9,279,057 tons reported to the Bureau in 1935.

[11] Allowances for capacity sold in 1936 are based upon the reported number of machines sold during the year and the average tonnage loaded by machines of similar type in 1935, as shown by detailed reports of mine operators to the Bureau of Mines.

[12] Mining and Metallurgy, January 1937, p. 37.

153336—37——4

REGIONAL DISTRIBUTION OF MACHINES, BY TYPES

The maps in figures 17 to 20 are designed to bring out the striking differences in the regional distribution of the principal types of loading machinery over the coal fields of the country. Differences in seam conditions have led to the selection of equipment considered by the operator best suited to local needs. The existing distribution of equipment is affected further by the past variations in wage scales already cited and by the dates at which the equipment was installed. Operators who invested in one type of equipment in 1927 might choose a different type in 1937. It is recognized that machines successful in one area may fail in another, and the problem of selection is the subject of active discussion. Improvements in design and in operating practice are adapting mobile loaders to conditions formerly thought suited only to conveyors and vice versa, and the future distribution of equipment may differ widely from that of today.

Mobile loading machines.—Figure 17 shows the location of mobile loading machines that had been installed underground in coal mines down to January 1, 1937. It includes all machines reported as in use by mine operators during 1935 plus the shipments reported by manufacturers in 1936. The map, therefore, gives a trustworthy picture of the regional distribution of mobile-type machines down to the beginning of 1937.

The map shows in outline the important coal-mining counties that produce 100,000 tons or more in a normal year. Each black dot represents four loaders (or major fraction of four), and the hollow circles represent counties in which there are one or two machines only. Counties left blank were using no machines of this type, so far as known, at the beginning of 1937.

Mobile loaders represent the largest unit investment and have the largest hourly capacity of the several types of machines. Where conditions favor their use mobile loaders therefore effect the largest saving in labor, and in 1935 they produced more bituminous coal than all other types of machines combined. The conditions favoring mobile loaders are thick seams, good roof, flat or gently dipping beds, and the absence of thick partings or bands of impurities in the seam. Naturally, these factors rarely exist in ideal combination, and mobile loaders have been successfully used in many localities under more difficult conditions. Various designs of mobile loaders are available to work seams as thin as 30 inches.

Machines of this type, however, have been used most widely in certain clearly marked areas. These include the thick beds of the Illinois-Indiana field; Carbon County, Utah; Carbon and Sheridan Counties, Wyoming; the Roundup field of Musselshell County, Mont.; and, within the last 2 years, the Pittsburgh bed in northern West Virginia and the Logan field of southern West Virginia. The Pittsburgh bed in Pennsylvania and eastern Ohio has been the scene of persistent and determined effort to adapt mobile loaders under difficult roof conditions; and considerable success has been attained, with promise of more hereafter.

An obstacle to the use of mobile loaders—and of other machines that eliminate hand shoveling entirely—is the presence of dirt bands or partings in the coal. Hand loading affords an opportunity to miners to reject the impurities as they shovel the coal. Loading machines cannot do this, and unless the problem can be handled by improve-

ments in face preparation, the partings being cut out before the face is shot, it may be necessary to install mechanical cleaning equipment on the surface at considerable expense. Many mines installing mobile loaders have therefore put in mechanical cleaners as well; and where the economies underground are large, the added expense in preparation has been readily absorbed. But in still other cases the cost of mechanical cleaning favors the selection of alternative types of underground equipment.

Duckbills.—Self-loading conveyors, of which those equipped with duckbills are by far the dominant type, combine virtual elimination of hand shoveling with the transport function of conveyors. Duckbills are therefore handicapped by partings or impurities in much the same way as are mobile loaders. Duckbills have found their greatest

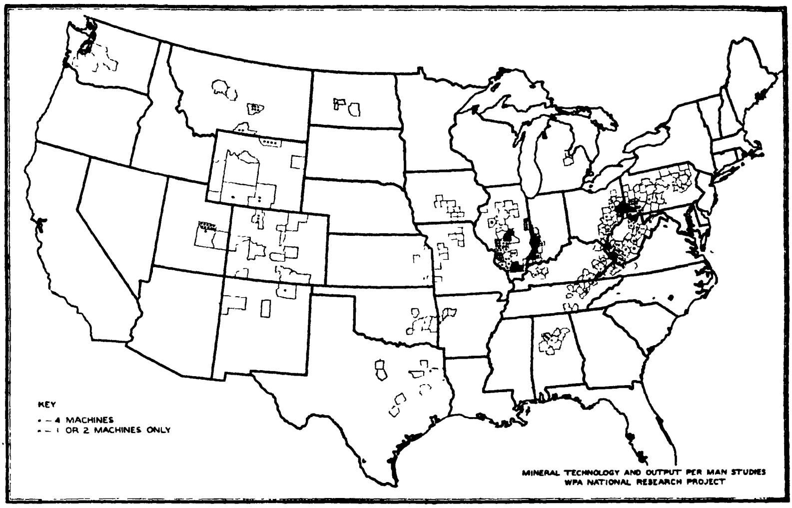


FIGURE 17.—Distribution of mobile loading machines installed underground in coal mines at the beginning of 1937.

The map shows in outline the counties producing 100,000 tons or more of coal in a normal year. Each black dot represents four mobile loading machines. Counties in which one or two machines only were installed are indicated by circles. Other counties were using no machines of this type in 1936, so far as known.

utility in areas where the seams pitch too steeply for the ready use of mobile-type machines, and many of the areas showing use of duckbills in figure 18 are characterized by moderate to steep dips. Duckbills have also been employed to advantage in thin seams especially adapted to conveyor mining and are used in this way in the anthracite and a number of the bituminous fields. In 1935, 30 machines were reported by operators in the anthracite region and 179 in the bituminous fields. Duckbill-equipped conveyors have been most widely employed in the mines of southern Wyoming, where these machines were invented and originally developed.

Scrapers.—Installations of scrapers are indicated in the same map (fig. 18) by the symbols *X* and *Y*. By far the greatest centers where scrapers are employed are the Northern and Western Middle anthracite fields, and in several counties of the anthracite region so many scrapers are used that the county appears on the map as solid black. In 1935, 507 scraper units were in active use in the anthracite region, and manufacturers reported sales of 9 additional units to this area

in 1936. However, the number of new installations is now small compared with the number of conveyors.

In the bituminous-coal fields scrapers have been retarded by two factors of little consequence in the anthracite region. Where the coal is friable scrapers may greatly increase degradation, and where the bottom is soft they may scour up dirt and increase the ash content of the product. Partly for these reasons the total number of scraper installations in the bituminous-coal fields has been declining since 1930.

Under certain conditions scrapers are used to advantage, particularly in narrow or long wall work, in thin or inclined beds. Among the centers of present use are Indiana County, Pa.; Walker County, Ala.; Colfax County, N. Mex.; and southern Wyoming.

In Arkansas and eastern Oklahoma a modification of the scraper idea, known as the scow, has been used with marked success in mining thin seams. Scows are more cousins than brothers of scrapers. They consist of a steel plate which is pushed into the kerf or undercut made with the cutting machine. The coal is then broken onto the scow and dragged to a loading platform. Scows, therefore, avoid the degradation and the mixing of bottom impurities with the coal which often handicap scrapers proper.

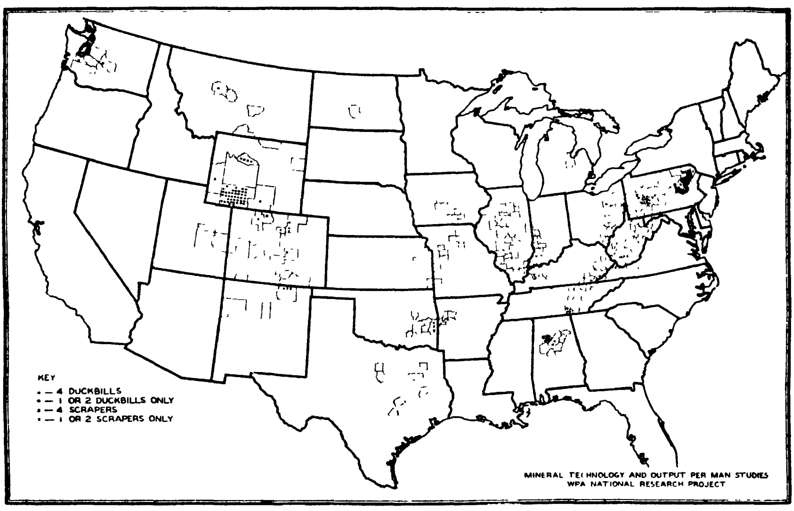


FIGURE 18.—Distribution of duckbill-equipped conveyors and of scrapers installed underground in coal mines at the beginning of 1937.

Pit-car loaders.—The period of greatest activity in the installation of pit-car loaders was 1927 to 1931. During that period great numbers of these machines were introduced in the mines of Illinois and Indiana and, to a smaller extent, in certain other fields. Pit-car loaders involved a much smaller investment and less modification of standard room-and-pillar practice than other types of loading machinery. Although the savings in labor were less than with mobile-type machines, at the wage scale then prevailing in the Middle West pit-car loaders permitted a definite reduction in cost. In late years few new machines of this type have been sold. Large numbers remain in use, however (fig. 19). The centers of greatest activity are the Belleville and Central Illinois fields; the Southern Illinois field; the Danville district of

Illinois; Indiana; the Pittsburgh bed in Pennsylvania; and St. Clair and Jefferson Counties, Ala.

Pit-car loaders, however, appear in smaller numbers in some other fields of the country, and there are undoubtedly possibilities for their successful application.

Face conveyors.—Figure 20 shows the distribution of the hand-loaded conveyors installed underground down to the end of 1936. The figures include all types of conveyors—chain, shaker, or belt—except those equipped with duckbills, which have been previously shown in figure 18.

The number of conveyor installations has been increasing rapidly in both the anthracite and bituminous-coal fields. In the anthracite region conveyors have established themselves as the dominant type of loading machinery and in 1935 handled about 70 percent of the tonnage loaded with mechanical devices. In the bituminous-coal fields the conveyors have increased their share of the total tonnage mechanically loaded from 13.4 percent in 1928 to 16.3 in 1935.

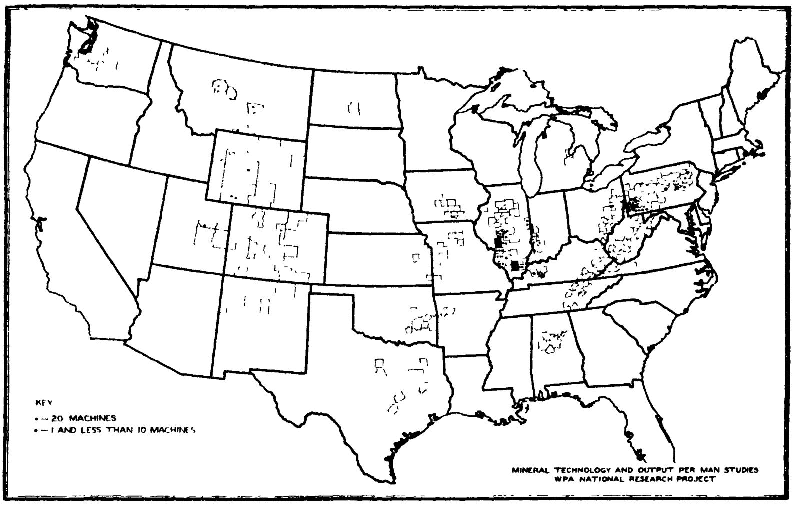


FIGURE 19.—Distribution of pit-car loaders installed underground in coal mines at the beginning of 1937.

Up to the present the labor savings effected with the use of conveyors have been much smaller, on the average, than with mobile-type machines. Conveyors do not eliminate hand shoveling, though they greatly reduce the labor by reducing the height to which miners must lift the coal and the distance to which they must cast it. Some recent conveyor installations, however, suggest that past performance is far from indicating their future potentialities.

Conveyors have been found applicable under certain conditions where mobile-type loaders are handicapped, and they are the type of machine most widely used in thin beds. Beds too thin to yield the concentration of tonnage that makes best use of the higher capacities of mobile loaders have been worked successfully with conveyors. Moreover, the conveyors perform a function of transport, and where, as sometimes happens, they eliminate expensive brushing of top or taking up of bottom to provide clearance for mine cars and mules or locomotives, they may effect substantial savings. Inclined seams are

no obstacle to conveyors of suitable design, and some dips too steep for application of mobile-type loaders have therefore been mechanized in this way.

A further advantage of conveyors is their adaptability to the working of seams containing partings or impurities. As the coal is shoveled onto conveyors by hand, opportunity is offered for hand-picking of refuse, much as with hand-loading proper. If necessary, inspectors can be stationed along the conveyor lines, and the car trimmer who tends the discharge end of the conveyor is universally instructed to watch for pieces of slate as the coal passes into the mine car. With these possibilities for hand cleaning, conveyors can be installed without material sacrifice of quality in a seam where the amount of impurities would necessitate installation of mechanical cleaning if the loading were mechanized with mobile-type machines.

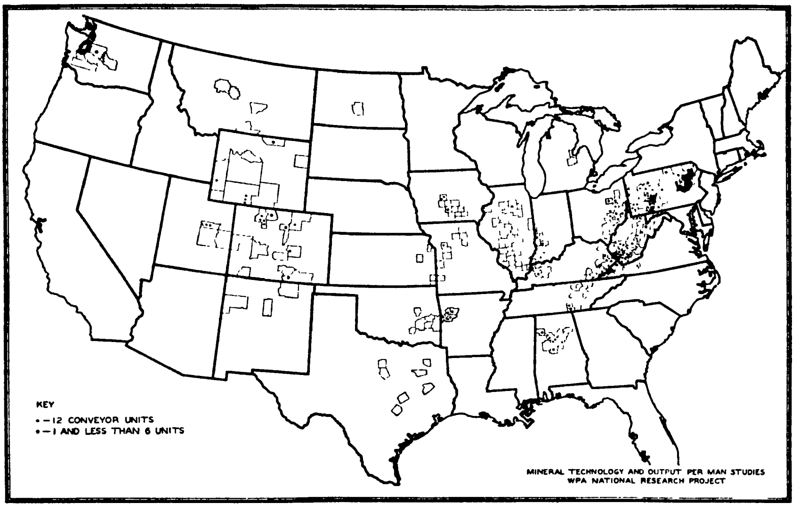


FIGURE 20.—Distribution of hand-loaded conveyors installed underground in coal mines at the beginning of 1937.

As might be expected from these considerations, conveyors are little used in the thick, flat seams of Illinois and Indiana, and, in general, the areas where the mobile loaders are most widely used have shown little interest in conveyors. The largest single field for conveyors has thus far been the Pennsylvania anthracite region, where there has been an extraordinary development in the use of such machines, particularly those of the shaker type. In the bituminous-coal fields the areas of greatest activity are the low-volatile districts of central Pennsylvania (especially Cambria, Somerset, and Indiana Counties), Alabama, Arkansas, southern Wyoming, and the Roslyn field of Washington. Within the last 2 years, the use of conveyors has spread rapidly in the Southern Appalachian region, and numerous installations are reported in both the low- and high-volatile districts. Western Pennsylvania, also, reports active interest in the possibilities of conveyor mining.

Combined installations.—The maps showing the present distribution of machines emphasize the fact that expert opinion regarding the selection of mechanical loading equipment is in a state of flux and

that new adaptations are likely to appear. One possible development which deserves watching is the combination of mobile loaders and conveyors in the same mine, a system that should yield economies both in loading and in transportation.

Sales, by regions, in 1936.—The location of sales of new equipment made in 1936 cannot be shown in detail without disclosure of the business of individual manufacturers. Insofar as the figures can be properly broken down, they are given in tables 28 and 29 of the section on Bituminous coal in the Coal chapter of the Yearbook.

MECHANICAL LOADING IN METAL AND NONMETAL MINES

By N. L. Plein, F. E. Berquist, and F. G. Tryon

Mechanical loading with both scrapers and power shovels established itself underground in the metal mines even earlier than in coal mines, and there is an extensive technical literature on the problems of mining practice that it has raised. Up to the present, however, there have been no statistics to show either the number of machines or the tonnage of ore mechanically loaded.

The figures here presented are no more than a reconnaissance, designed to indicate the trends of mining practice in the application of loading machinery. If omissions are noted, the authors will welcome criticism or supplementary data that will make the record more complete.[13]

TONNAGES MINED UNDERGROUND AND THE FIELD OF MECHANIZATION

Some idea of the potential use of subsurface loading equipment may be gained by reviewing the tonnage of minerals now produced by underground mining in the United States. The metals and the nonmetals will be briefly considered.

Metallic ores.—Not counting the 71,000,000 tons won from open pits, which represent another phase of mechanization, the following table shows a total of more than 98,000,000 tons of ore produced from underground.

Tonnages of ore classified according to mining methods at metal mines producing $100,000 or more in 1929

[Quoted from C. W. Wright, Mining Methods and Costs at Metal Mines of the United States: Inf. Circ. 6503, Bureau of Mines, 1931, p. 5. The 405 mines covered produce 95 percent of the total output of metallic ore. Figures in short tons]

Mining method	Gold ore, tons	Copper ore, tons	Silver, lead, and zinc ore, tons	Iron ore, tons	Total tons, ore	Percent of total tonnage of ore	Percent of total man-hours of labor
Underground:							
Square-set	379, 022	4, 318, 294	3, 121, 746		7, 819, 062	4. 6	24. 8
Cut-and-fill	13, 150	1, 573, 135	664, 252	305, 575	2, 556, 112	1. 5	6. 8
Shrinkage	5, 645, 110	2, 306, 930	2, 011, 500	1, 070, 608	11, 034, 148	6. 5	9. 0
Open-stope	364, 516	6, 121, 545	15, 502, 250	13, 298, 362	35, 286, 673	20. 8	24. 6
Top slicing				15, 904, 288	15, 904, 288	9. 4	9. 1
Sublevel caving				7, 303, 976	7, 303, 976	4. 3	4. 3
Block caving		18, 576, 196			18, 576, 196	10. 9	7. 2
Total underground	6, 401, 798	32, 896, 100	21, 299, 748	37, 882, 809	98, 480, 455	58. 0	85. 8
Surface:							
Open-pit		31, 605, 847		39, 883, 064	71, 488, 911	42. 0	14. 2
Grand total	6, 401, 798	64, 501, 947	21, 299, 748	77, 765, 873	169, 969, 366	100. 0	100. 0

[13] The authors are indebted to Chas. F. Jackson, chief engineer, Mining Division, and E. W. Pehrson, Metal Economics Division of the Bureau of Mines; also to J. R. Thoenen, George C. Heikes, and H. P. Sweeny, of the Bureau, for field notes and criticism.

A review of the systems of mining used should give a rough idea of the outer limits of possible mechanization. That the limits are necessarily uncertain, any mining man will realize. No two mines are alike, and the statistical groupings conceal a great variety of conditions. Each mine in such a count has to be classified according to the dominant method employed, yet numerous mines utilize more than one method to meet local variation in conditions. Hence the same mine may profitably employ mechanical loading devices in one section and gravity or hand loading in another.

On the other hand, nearly all mines produce some ore from development work, and the marked savings in cost or increase in speed often obtained by mechanical loading in drifts and headings indicate that in the future all mines may load some ore mechanically.

It appears at once that most of the 7,800,000 tons mined with square-sets can hardly be machine loaded, either because of closeness of timbering or other factors. The most that can well be anticipated here is a gradual shift to other systems of mining, which in some instances may offer greater scope for mechanization.[14]

On the other hand, a much larger fraction of the total tonnage is mined by methods in which the work of loading into cars and even the movement of ore within the stopes is accomplished by gravity. Bituminous-coal engineers envy metal miners their opportunity to tunnel under the mineral and draw it out in this way, and it seems clear that no effort will be spared to make gravity do the work and that the proportion produced by block caving and by shrinkage will tend to increase, wherever the ore bodies are suited to those methods. Even here there may be room for auxiliary employment of loading machinery, as scrapers are used at Climax, Colo., in working a massive deposit adapted to shrinkage or caving.

This leaves the tonnages produced by open-stope, top-slicing, sublevel-caving (in the Lake Superior iron country), and cut-and-fill methods the principal candidates for mechanical loading. Indeed, in many mines using these methods the application of scrapers or power shovels is already far advanced.

The table, however, shows nothing of the large amount of country rock it is often necessary to handle either in accessory construction or in current development work. Recent experience emphasizes the savings of power loading in driving tunnels or headings, whether in rock or ore. The aggregate tonnage involved is great, and it offers one of the principal fields for mechanical loading below ground.

Nonmetals.—Finally, it is necessary to reckon with the surprisingly large tonnage of nonmetallic minerals now obtained from underground workings. Some idea of the possibilities in this direction is given by the following table, which indicates a total of 18,528,000 tons of crude material taken from underground in the year 1929. Much of this is already mined mechanically, and still more is likely to be.

[14] Wright, C. W., Mining Methods and Costs at Metal Mines of the United States: Inf. Circ. 6503, Bureau of Mines, 1931, pp. 32–33.

Approximate tonnage of the principal nonmetals produced by underground mining, 1929

[Wherever possible, figures represent the tonnage of crude material hoisted before beneficiation]

	Short tons mined underground		Short tons mined underground
Limestone [1]	11, 108, 317	Fluorspar	130, 000
Gypsum	2, 708, 711	Phosphate rock (1935)	113, 928
Rock salt	2, 113, 010	Miscellaneous nonmetals	500, 000
Clay [1]	786, 874		
Pyrites (1935)	566, 961		18, 527, 801
Potash (1935)	500, 000		

[1] Census of Mines and Quarries, 1929, pp. 369 and 393. The figures for clay represent only enterprises whose product was sold as clay and exclude mining operations of clay-products manufacturers. In addition, 432,866 tons of clay were mined by companies producing from both underground and surface workings at the same operation.

TOTAL NUMBER OF LOADING UNITS SOLD

Sales of scrapers and shovel loaders to operators of metal and nonmetal mines in each year from 1923 to date are summarized in the table following:

Number of scraper loaders and shovel loaders sold for use underground in metal and nonmetal mines

[Figures represent sales to mines in the continental United States, not including exports or sales to contractors on construction projects. Subject to revision]

Year	Scraper loaders (hoists or complete units)	Shovel loaders	Year	Scraper loaders (hoists or complete units)	Shovel loaders
1923	254	57	1931	126	2
1924	341	18	1932	104	14
1925	373	15	1933	62	12
1926	284	36	1934	67	23
1927	414	39	1935	135	44
1928	363	32	1936	249	70
1929	645	35			
1930	335	22		3, 752	419

This information is based primarily upon reports from 11 manufacturers of shovels and 8 manufacturers of scrapers and scraper hoists. Direct reports could not be obtained on one make of shovel no longer actively produced, and one manufacturer of hoists had not reported when the books were closed. To round out the figures, an estimate has been included in these two cases, derived from lists of installations furnished by State mine inspectors and by correspondents in the field.

The following manufacturers of mechanical loading equipment have cooperated for the purpose of this inventory:

Manufacturers of underground scraper loaders or hoists

Sullivan Machinery Co., Chicago, Ill.
Gardner-Denver Co., Quincy, Ill.
Lake Shore Engine Works, Marquette, Mich.
Goodman Manufacturing Co., Chicago, Ill.
Vulcan Iron Works Co., Denver, Colo.
Vulcan Iron Works, Wilkes-Barre, Pa.
Lidgerwood Manufacturing Co., Elizabeth, N. J.
Sauerman Bros., Chicago, Ill.

Manufacturers of underground shovel loaders

The Eimco Corporation, Salt Lake City, Utah; Eimco-Finlay loader.
Gardner-Denver Co., Quincy, Ill.; Gardner-Denver loader.
Nordberg Manufacturing Co., Milwaukee, Wis.; Nordberg-Butler shovel.
Goodman Manufacturing Co., Chicago, Ill. (with St. Louis Power Shovel Co.); Conway and Goodman power shovels.
The Thew Shovel Co., Loraine, Ohio; Thew and St. Joe type shovels.
The Marion Steam Shovel Co., Marion, Ohio; Marion shovel.
Allis-Chalmers Manufacturing Co., Milwaukee, Wis.; Hoar shovels.
Harnischfeger Corporation, Milwaukee, Wis.
Jeffrey Manufacturing Co., Columbus, Ohio; Mobile loaders.
Myers Whaley Co., Knoxville, Tenn.; Myers Whaley shoveling machine.
The Osgood Co., Marion, Ohio; Osgood shovels.

The total number of machines sold to metal and nonmetal mines during the 14-year period from 1923 to 1936 is placed at 419 shovel loaders and 3,752 scrapers. These figures undoubtedly include many experimental installations, which were sometimes only partly successful and sometimes even abandoned. In coal mining, for instance, there are records of 459 mines which at one time or another have tried mechanical loading without adopting it as standard practice, at least down to. the end of 1936. Difficulties in the design of machines, in local seam conditions, and in adaptation of mining methods have combined with market and wage-rate factors to delay wider use of coal loaders. A similar record of trial and error has undoubtedly occurred in the metal mines.[15] These cases of partial success or failure are no more than enough to suggest the need of careful study of local conditions and comparison of the alternative types of equipment available before making the investment in loading machinery.

SCRAPER LOADERS

Details of the early installations of scrapers underground will be found in a monograph by C. E. van Barneveld on mechanical loading in metal mines.[16] Figure 21 picks up the trail where van Barneveld left it in 1923. By that time scraper loading was going forward with a rush. The pioneer installations in the Michigan copper mines and the Lake Superior iron ranges in 1915–17 and in the Tri-State area in 1919 had proved the possibilities of scrapers at a time when shortage of manpower and rising wages focused the attention of managers upon labor-saving devices.[17] In the post-war years, declining prices both of iron and the nonferrous metals further stimulated the search for cost reduction. Throughout the period from 1923 to 1929, sales of scraper equipment continued in large volume. Indicative of the savings effected is the record of Gogebic County, Mich., where the output of iron ore per miner per day is reported to have increased from 2.91 tons in 1923 to 5.96 in 1929.[18]

By far the largest number of machines went to the iron country of Michigan and Minnesota and to a smaller extent Alabama, the peak in number sold being reached in 1929. The great depression fell with exceptional severity on the iron industry, and sales of equipment

[15] Trans. Am. Inst. Min. and Met. Eng., vol. 72, 1925, pp. 67, 261, 300, 365, 412; vol. 96, 1931, p. 46. Anderson, C. N., Mining Methods and Costs and the Interstate Zinc & Lead Co.'s Hartley Mine, Tri-State Zinc and Lead District: Inf. Circ. 6656, Bureau of Mines, 1932, p. 8.
[16] van Barneveld, Charles E. (mining engineer, U. S. Bureau of Mines), Mechanical Underground Loading in Metal Mines: Univ. of Missouri, Sch. Mines, vol. 7, no. 3.
[17] Jackson, Chas. F., Underground Scraping Practice in Metal Mines: Manuscript Rept. 1, Bureau of Mines (printed by Sullivan Machinery Co.), 1933, p. 9.
[18] Sullivan Machinery Co., Handbook of Scraper Mucking: Publication 176, 1931, p. 7.

dropped by 1933 to a small fraction of the former level. Recovery of business sent the curve of sales upward, and there were further increases in 1935 and 1936. Were it possible to represent the capacity of the equipment rather than the number of units, the sales in 1936 would appear substantially higher, for meanwhile there has been a marked increase in size of typical scraper hoists. In 1923, 4- to 7½-horsepower hoists were the rule; now they range up to 150 horsepower and use much heavier equipment and larger scrapers.

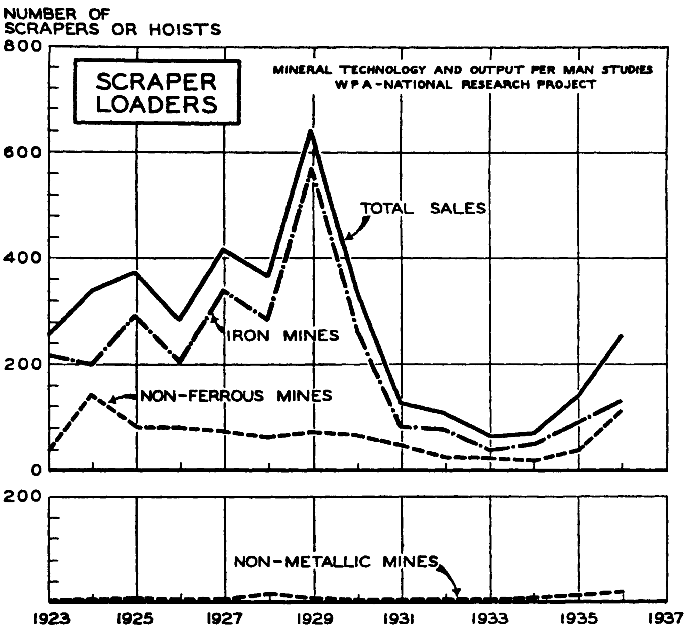


FIGURE 21.—Shipments of scraper loaders for use underground in metal or non metal mines, 1923-36. Note that the figures represent number of units only without regard to capacity. Were it possible to allow for the large increase in the size of machines during this period, the sales in recent years would look proportionately larger. Based upon detailed reports from eight manufacturers, with an estimate for one company not heard from when the books were closed.

As scraper mining has become the established practice in the Lake Superior iron mines, wherever it is applicable,[19] future installations in this area will hardly equal those of the 1920's, when the mines were being initially equipped. It is evident, however, that a substantial demand for this type of equipment will continue to be found in replacements and in retirement of obsolete machines. In the Alabama iron mines, scrapers have been widely [20] used, but a considerable part of the district output is still loaded by hand.

In nonferrous-metal mining, one of the largest single fields for the use of scrapers until recently has been the Michigan copper mines. Along with power drilling, concentration of haulage, and selective mining, the use of scraper loading has been one of the principal economies that have enabled the Michigan mines to combat the difficulties of increasing depth and to survive in the competitive struggle.[21]

[19] Matson, Robert C., Scraping Practice in the Michigan Iron Mines: Michigan Coll. Min. and Technol. Bull. 1928-29, vol. 2, no. 4, p. 1.
[20] Eaton, Lucien, Mechanical Loading in Metal Mines in 1929. Min. Cong. Jour., July 1929, p. 536.
[21] van Barneveld, C. E., Work cited (footnote 16), p. 337.
Crane, W. R., Mining Methods and Practice in the Michigan Copper Mines: Bull. 306, Bureau of Mines, 1929, 192 pp.

Purchases of scrapers by nonferrous and precious metal mines reached a peak about 1924 and for some years thereafter declined. Beginning in 1935, however, there was a sudden pick-up, apparently forecasting further activity in this field. A notable feature of the last 2 years has been the increase in sales to precious-metal mines, reflecting the boom in gold production that followed devaluation of the dollar.

The growth of scraper loading in metal mines is in contrast to the experience of coal mines. Numerous coal mines—both bituminous and anthracite—working thin or pitching seams have tried scrapers, and some 3,800,000 tons of coal are loaded in this way. But in coal

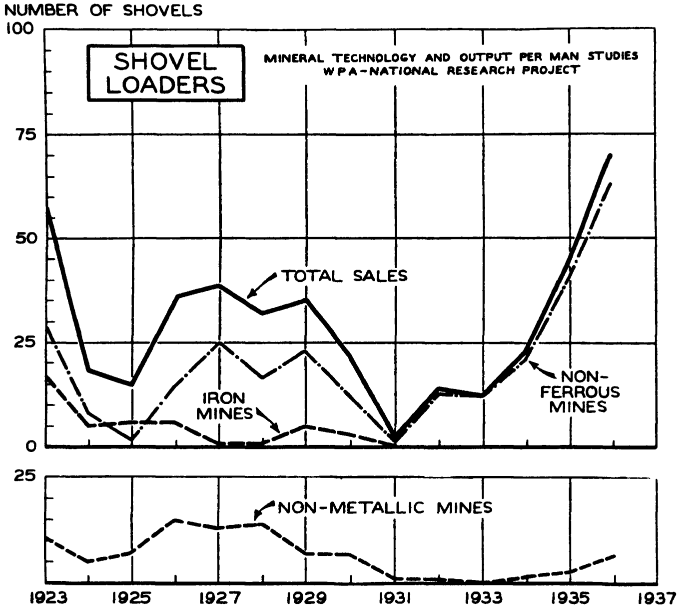


FIGURE 22.—Shipments of shovel loaders for use underground in metal or nonmetal mines, 1923-36. Based upon detailed reports from 11 manufacturers. Includes estimates for 1 make of machines not now produced.

mines the scraper may often gather up dirt as it drags along the floor, thereby increasing the ash content of the product; and it also increases breakage and reduces the proportion of the profitable domestic sizes. In metal mining, these considerations do not apply.

Nonmetallic mining, like coal, has made less use of scrapers than of shovel loaders underground.

SHOVEL LOADERS

Installations of shovel (or mobile-type) loaders during the same period are shown in figure 22. The record for shovel loaders covers two distinct types of equipment. From 1923 to 1931 the machines sold consisted chiefly of comparatively large units designed for loading in open chambers or stopes. Beginning about 1932, the record is dominated by the sale of smaller-type machines designed primarily for loading in headings or tunnels. Machines of both kinds have been sold in both periods, but there has been a definite shift of emphasis.

Marked activity in the use of power shovels of the first type had occurred before the diagram begins. The largest number of machines

had gone into the southeast Missouri disseminated-lead mines. Favorable conditions and progressive management in that field have given it a preeminence in the use of power shovels underground.

The first experiment with a power shovel in the district was made in 1912, but the abundance of hand shovelers and the low rate of wages then prevailing were found to yield little incentive to mechanize at that time.[22] The World War, however, stimulated a reconsideration of mechanical loading. The munitions demand, coinciding with the shortage of labor, led to the reintroduction of machines in 1917. Improved machines were developed, adapted to the conditions underground, and by November 1923 a total of 55 power shovels was in use in the field.[23] Since then installation of machines has continued at less rapid rate, and steady advances have been made in the efficiency of operation. In this area mechanical loading has now replaced hand shoveling entirely, except for incidental clean-up. An indication of the saving in labor effected is found in the report that in one mine of southeast Missouri machine mucking requires 0.061 man-hour per ton and hand mucking 0.416 man-hour per ton.[24]

Power shovels of the larger types were purchased by a number of other metal mines. They were also the predominant type of equipment installed for underground loading in nonmetallic mineral mines. Sales of the larger types of shovels continued through the great depression, though naturally on a diminished scale.

The last 5 years, however, have witnessed a remarkable activity in the use of smaller shovels of the second type, designed especially for driving tunnels and headings, either in rock or in the vein. Machines for such development work had appeared upon the market during and just after the war [25] but achieved no general acceptance. Recent improvements seem to have overcome earlier difficulties, and the greater part of the shovels sold from 1934 to 1936 consists of such smaller machines. As the curves in figure 22 represent the number of machines only, without regard to size, the increase indicated is somewhat greater than would appear if figures on daily capacity were available.

The curves as plotted include domestic sales only. In addition, both scrapers and shovel loaders are shipped abroad. In the last 3 years there have been substantial exports, particularly of small tunneling shovels.

CONVEYORS

In 1935, more than 6,600,000 tons of anthracite and 10,285,309 tons of bituminous coal were loaded with conveyors, chiefly of the shaker type, but thus far conveyors are little used in other mines. However, the manufacturers reporting in this survey indicate that a few conveyors have gone into both metal and nonmetal mines. Belt conveyors are used as part of the transportation system at the Butler Bros. iron mine in Minnesota.[26] The Morton Salt Co. at Grand Saline, Tex., uses scrapers to load shaking conveyors in the rooms. The conveyors then carry the salt to the main entry where other conveyors of the belt type carry it to the shaft. No cars are used in this mine.[27] It is also reported that shaker conveyors are being tried in

[22] van Barneveld, C. E., Work cited (footnote 16), p. 296.
[23] van Barneveld, C. E., Work cited (footnote 16), p. 400.
[24] Jackson, Chas. F., Methods of Mining Disseminated-Lead Ore at a Mine in the Southeast Missouri District: Inf. Circ. 6170, 1929, Bureau of Mines, p. 21.
[25] van Barneveld, C E., Work cited (footnote 16), pp. 10, 11.
[26] Engineering and Mining Journal, March 1936, p. 138.
[27] Weigel, W. M., The Salt Industry of Louisiana and Texas: Am Inst. Min. and Met. Eng., Tech. Pub. 620, 1935, p. 16.

the bedded iron ores of Lorraine.[28] These devices appear to have distinct possibilities in mining flat beds of the less abrasive materials.

FIELD DISTRIBUTION OF INSTALLATIONS OF LOADING MACHINERY

Figures 23 to 25 have been prepared to indicate the wide distribution of mechanical loading equipment underground.

Iron mines.—Figure 23 shows the localities where scrapers or shovel loaders have been introduced into the iron mines. Each circle represents an area where scrapers have been installed below ground, according to the manufacturers' records, in the period from 1923 to 1936. The number of circles is far from showing the total number of units sold and may give a mistaken impression of the relative importance of the different areas unless it is remembered that one dot standing for a single large area purchasing scores of machines may represent more than numerous scattered dots in areas of smaller production.

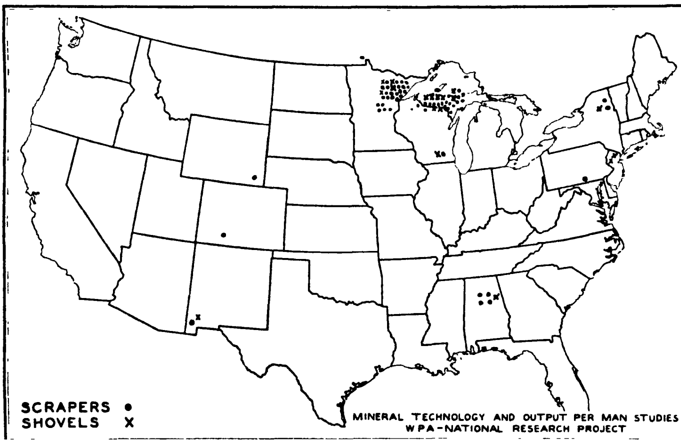


FIGURE 23.—Localities in which scraper and shovel loaders have been introduced underground in iron ore mines.

Each circle or X indicates a locality in which loading equipment of one make or another was installed during the period from 1923 to 1936. Doubtless not all of the localities indicated are actively using the equipment at the present time.

In the same way, each cross mark in figure 23 represents an iron-mining locality where one or more power shovels were sold. It should be noted that a considerable number of earlier types had been installed before 1923. Were these machines included in the map, the number of iron-producing localities making use of shovel loaders would appear larger.

The map, however, emphasizes the fact that in iron mines the scraper has been the dominant type of mechanical equipment used in underground loading. It demonstrates also that purchases of loading machinery have been made in virtually every iron-mining district of the country, though some of the installations were experimental and doubtless not all of them are in active use today.

Nonferrous-metal mines.—Figure 24 illustrates in the same way the widespread interest in mechanical loading in the mines producing nonferrous and precious metals. Nearly every district of major im-

[28] Jacob, Louis, Transporting Iron Ore by Electrically Driven Shaker Conveyors at the Ottange 2 Pit, Moselle, France: Trans. 7th Session, Internat. Cong. Mining, Metallurgy, and Applied Geology, Paris, 1935.

portance has purchased at least some units of scraper or shovel equipment. No attempt is made to indicate the relative number of units; hence the southeast Missouri lead district, now 100 percent mechanized, is not much more conspicuous on the map than the Tri-State area, in which the number of installations has been small.[29] These two districts, lying side by side, illustrate how largely the factors of size of operation and character of deposit affect the utilization of machinery. In the Tri-State area, the less regular character of the mineralization and of the underground workings, smaller holdings, prevalence of the leasing system, use of small "cans" instead of large capacity cars in haulage, and other factors have worked to favor hand loading. Nevertheless, adaptation of power loading to the conditions of this district also would appear largely a matter of time.

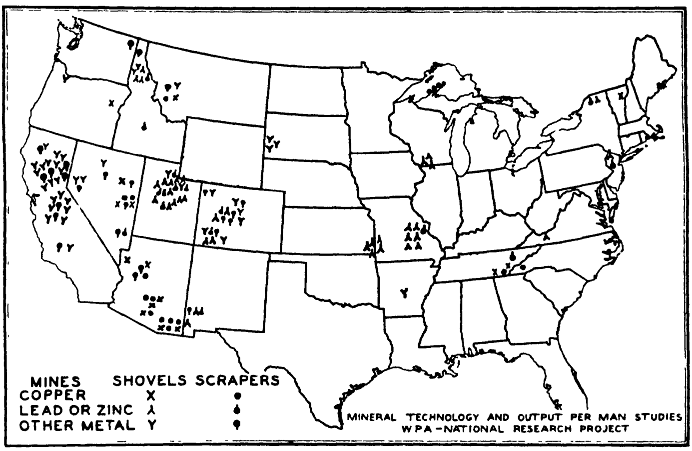


FIGURE 24.—Localities in which scraper and shovel loaders have been introduced underground in nonferrous metal mines.

As each symbol represents a locality installing machinery, the map gives no direct indication of relative importance in number of units sold. Thus the southeast Missouri lead district purchased scores of machines, whereas the adjacent Tri-State area has installed but few.

The conspicuous feature of the map is the large number of localities that have made use of loading machinery in the metal mining districts of the West. Every important metal is represented in the list—gold and silver, copper, lead and zinc, bauxite, manganese, vanadium, and molybdenum. Both scrapers and shovels are widely represented, and there are signs of rivalry between the two both for mucking in stopes and for development work.

The predominant consideration underlying the introduction of machines is one of cost. In some areas the item of cost alone is now reinforced by the increasing temperatures attendant upon depth. Magma, Bisbee, and some of the hotter workings at Butte are examples that might be cited of mines where the rock temperatures now encountered make the arduous labor of hand shoveling increasingly difficult or impossible.

Nonmetals.—As shown by figure 25, the distribution of loading equipment in nonmetal mines is largely concentrated in the Mississippi Valley and the East. The types of equipment chiefly used are power shovels or smaller mobile-type loaders, though scrapers also are widely

[29] Anderson, C. N., Mining Methods and Costs at the Interstate Zinc & Lead Co.'s Hartley Mine, Tri-State District: Inf. Circ. 6656, Bureau of Mines, 1932, p. 8.

distributed. The industries making greatest use of such equipment are underground limestone mining and rock salt.[30] Metal miners are not always aware that the production of limestone underground has grown from 1,670,000 tons in 1912 to 11,100,000 [31] in the active year 1929. Some of this production is obtained from steeply pitching beds by shrinkage methods and gravity loading,[32] but the greater part is loaded with underground power shovels. Loading machinery has also been used, sometimes experimentally, in the underground mining of fireclay,[33] silica rock, glass sand, building sand, gypsum, phosphate rock,[34] ocher, pyrites, rock asphalt, fluorspar, and diatomaceous silica rock. Its most recent application is in the mining of potash in the newly developing industry at Carlsbad, N. Mex., where 98 percent of the production is produced with loading machines and scrapers.[35]

The trends in mining practice suggested by the sales of equipment indicate an active interest among mining engineers in the problems of mechanization and point to the need for studies of operating experi-

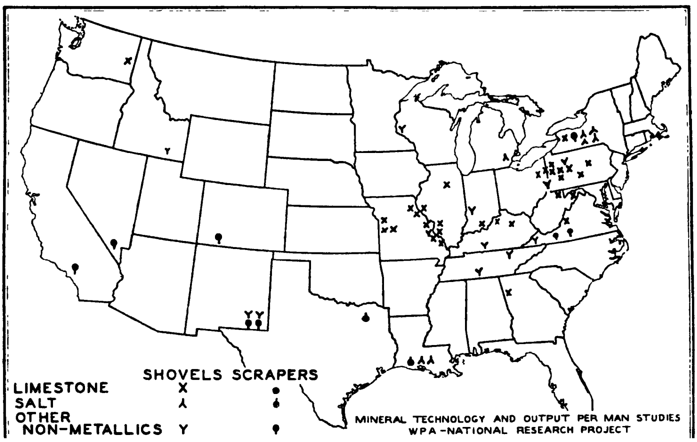


FIGURE 25.—Localities in which shovels and scraper loaders have been introduced in mining nonmetals underground.

In nonmetal mining the industries making greatest use of mechanical loading are limestone, salt, and potash.

ence in the application of machines under the widely varying conditions faced by practical miners. More time studies of mechanical loading are needed, especially loading in development work. The essence of all operating studies is adaptation to local conditions. The mass experience recorded in statistics is never a substitute for such individual analysis, but it may furnish a useful background. With the hope of providing such a background, the Bureau of Mines is adding to its annual reports of mine operation inquiries regarding the number and type of machines used and of the tonnage mechanically handled. A continuing analysis of the factors of mechanical equipment, mining practice, and man-hours per ton will, it is hoped, throw light on the current trends of mineral technology.

[30] La Vigne, E. F., Mining and Preparation of Rock Salt at the Retsof Mine: Am. Inst. Min. Met. and Eng. Tech. Pub. 661, p. 12.
[31] Census of Mines and Quarries, 1929, p. 369.
[32] Thoenen, J. R., Underground Limestone Mining: Bureau of Mines, Bull. 262, 1926, p. 69.
[33] Brick and Clay Record, Oct. 23, 1928, p. 577.
[34] Engineering and Mining Journal, 1930, vol. 129, pp. 195–196.
[35] Smith, H. I. and Ageton, R. V., Mechanization of the Potash Mines in New Mexico: Mec. Eng., July 1936, pp. 418–422.

STATISTICAL SUMMARY OF MINERAL PRODUCTION

(GENERAL UNITED STATES SUMMARY AND DETAILED PRODUCTION BY STATES)

By M. B. Clark

SUMMARY OUTLINE

INTRODUCTION

This report continues the series of annual statistical summaries published in previous years as chapters of Mineral Resources and of Statistical Appendix to Minerals Yearbook.

Review of the Mineral Industry, the first chapter of this volume, discusses the salient features of the mineral industry and various industrial and economic factors affecting it.

UNIT OF MEASUREMENT

The unit of measurement used by the Bureau of Mines for each mineral product in reports on the mineral resources is that common to the industry concerned, and the variation in these units makes it impracticable, if not impossible, directly to combine and compare the different minerals except as to value. Although most of the products are measured by weight, some are measured by volume, some by number of "pieces", etc., and for some no total quantity figures are available.

ELIMINATION OF DUPLICATION

In the totals for the United States, shown in the following "general" tables, duplication has been eliminated wherever practicable, and in the State totals given in the State tables virtually all duplication has been eliminated. For instance, in both general and State tables the output of coke is shown but its value is not included in the totals, as the value of the coal used in its manufacture enters into the value of the coal production which is included in the totals. For clay, the value of the products of the clay industries is included in both general and State totals as representing the first marketable form of the greater part of the clay produced; the quantity and value of the clay mined and sold in the raw state by miners to users of clay are shown separately also, but the value is not included in the totals as it is duplicated largely in that for clay products. No figures are available for total clay produced. For asphalt, both native and oil are shown in the gen-

eral tables, but the value of the oil asphalt is excluded from the totals as it duplicates that of the petroleum from which it is manufactured.

United States totals.—In the general tables both iron ore and pig iron are shown, but the value of the pig iron rather than the iron ore is included in the United States totals, as that is considered the better means of presenting the statistics for iron in its first marketable form. For gold, silver, copper, lead, and zinc the value of "smelter output" is included in the general totals, and to account more fully for the value of the ores treated these smelter figures are supplemented by the value of the byproduct sulphuric acid. The value of pigments (white lead, red lead, lithopone, litharge, and orange mineral) manufactured from metals is not included in the general tables, as the base from which they are made is included in the output of lead or zinc, whereas the value of sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide is included, as these are made in large part direct from the ores and do not enter into the lead or zinc totals, which represent smelter output.

State totals.—In the State tables also iron ore and pig iron are both shown. As blast-furnace products cannot be traced to the States in which the ore is mined, the value of the ore is used in the State totals. For ores of gold, silver, copper, lead, and zinc no values are shown, and in fact none are recorded; instead, for each of these metals the recoverable content of the ores is used as the basis of valuation. The value of the zinc and lead pigments is not included in the State total, as the recoverable zinc and lead content of the ores from which the products were made is included under zinc or lead. The value of the sulphuric acid produced as a byproduct of copper and zinc smelting and zinc roasting is not included in the State total, as tracing this product back to the State producing the ore has not been possible.

GENERAL TABLES

Mineral products of the United States, 1934–36 [1]

Product	1934 Quantity	1934 Value	1935 Quantity	1935 Value	1936 Quantity	1936 Value
METALLIC						
Aluminum........pounds..	74,177,000	$14,094,000	119,295,000	$22,070,000	224,929,000	$41,612,000
Antimonial lead........short tons (2,000 pounds)..	[2] 16,607	(2)	[2] 16,384	(2)	[2] 23,230	(2)
Antimony:						
Metal........do....	(3 4)	(3 4)	2,134	(3 4)	3,451	(3 4)
Ore and concentrates........do....	897	(5)	3,616	(5)	3,867	(5)
Bauxite........long tons (2,240 pounds)..	157,838	1,129,053	233,912	1,556,595	372,005	2,198,523
Cadmium........pounds..	2,777,384	(5)	3,477,091	(5)	3,633,495	2,889,000
Chromite........long tons..	369	4,653	515	6,163	269	2,978
Copper,[6] sales value........pounds..	488,454,107	39,076,000	762,587,340	63,295,000	1,222,819,396	112,499,000
Ferro-alloys........long tons..	428,798	34,634,957	592,176	48,891,592	853,531	69,135,074
Gold [7]........troy ounces..	3,091,183	108,191,400	3,609,283	126,324,900	4,313,122	150,959,270
Iron:						
Ore [4]........long tons..	25,792,606	[4] 66,483,846	33,426,486	[4] 83,034,561	51,465,648	[4] 131,740,594
Pig........do....	15,626,192	261,399,963	21,178,353	358,145,499	30,798,958	541,693,504
Lead (refined),[6] sales value........short tons..	299,841	22,188,000	310,505	24,840,000	387,698	35,668,000
Manganese ore (35 percent or more Mn)........long tons..	26,514	571,748	26,428	557,340	32,119	696,400
Manganiferous ore (5 to 35 percent Mn)........do....	221,822	621,090	524,184	1,322,611	940,519	2,235,366
Mercury:						
Metal........flasks (76 pounds net)..	15,445	1,140,845	17,518	1,261,121	16,569	1,324,194
Ore........short tons..	(8)	(9)	(8)	(9)	(8)	(9)
Nickel........do....	157	108,414	160	129,500	107	(5)
Ores (crude), old tailings, etc.:						
Copper........do....	11,717,000	(9)	19,103,000	(9)	(10)	(9)
Copper-lead........do....	121,000	(9)	1,000	(9)	(10)	(9)
Dry and siliceous (gold and silver)........do....	11,853,000	(9)	14,016,000	(9)	(10)	(9)
Lead........do....	3,360,000	(9)	3,494,000	(9)	(10)	(9)
Lead-zinc........do....	6,384,000	(9)	7,472,000	(9)	(10)	(9)
Zinc........do....	6,237,000	(9)	7,944,000	(9)	(10)	(9)
Platinum and allied metals (value at New York City)..troy ounces..	47,274	1,686,000	42,060	1,414,000	46,946	1,968,000
Silver [11]........do....	32,725,353	21,155,784	45,924,454	33,008,201	62,024,929	47,759,195
Tin (metallic equivalent)........short tons..	9	9,600	50	50,200	115	106,700

[1] In this general statement certain of the figures represent shipments rather than quantity mined, and some of the figures for 1936 are subject to revision. For details see following chapters of this volume.
[2] Figures represent antimonial lead produced at primary refineries from both domestic and foreign primary and secondary sources; no figures for value of antimonial lead available. Estimate of value of primary antimony and lead contents of antimonial lead from domestic sources included in total value of metallic products.
[3] Largely from foreign ore; Bureau of Mines not at liberty to publish figures.
[4] Value not included in total value.
[5] Value included in total value of metallic products; Bureau of Mines not at liberty to publish figures.
[6] Product from domestic ores only.
[7] According to Bureau of the Mint. Valued at $35 per ounce.
[8] Figures not available.
[9] Figures showing values not available.
[10] Figures for 1936 not yet available.
[11] According to Bureau of the Mint.

Mineral products of the United States, 1934–36—Continued

Product	1934 Quantity	1934 Value	1935 Quantity	1935 Value	1936 Quantity	1936 Value
METALLIC—continued						
Titanium ore:						
Ilmenite ... short tons	[5]	[5]	[5]	[5]	[5]	[5]
Rutile ... do	[5]	[5]	[5]	[5]	[5]	[5]
Tungsten ore (60 percent concentrates) ... do	2,049	$1,791,316	2,395	$1,921,017	2,612	$2,323,818
Uranium and vanadium ores ... do	[5]	[5]	[5]	[5]	[5]	[5]
Zinc,[6] sales value ... do	355,366	30,561,000	412,184	36,272,000	491,803	49,180,000
Total value of metallic products (approximate)		540,300,000		723,800,000		1,064,000,000
NONMETALLIC						
Arsenious oxide ... short tons	15,623	797,278	12,670	497,458	15,581	618,826
Asbestos ... do	5,087	158,347	8,920	292,927	11,012	309,994
Asphalt:						
Native ... do	440,852	2,365,750	347,397	2,148,761	577,637	3,193,995
Oil (including road oil) [4] ... do	2,515,628	[4] 23,413,386	2,715,104	[4] 24,111,959	3,607,603	[4] 31,790,935
Barite (crude) ... do	209,850	1,109,378	225,111	1,251,268	283,160	1,674,631
Borates (naturally occurring sodium borates and colemanite) ... do	242,500	4,822,014	272,967	5,381,560	313,759	6,156,123
Bromine ... pounds	15,344,290	3,227,425	16,428,533	3,483,239	20,609,025	4,038,438
Calcium-magnesium chloride ... short tons	76,719	1,153,159	83,546	1,039,103	125,911	1,909,908
Cement ... barrels (376 pounds net)	76,579,483	117,881,816	76,244,328	114,809,724	114,229,942	172,680,866
Clay:						
Products [12]		116,171,631		155,535,623		[12]
Raw [4] ... short tons	2,187,263	[4] 8,197,253	2,923,470	[4] 10,823,923	3,782,428	[4] 13,423,456
Coal:						
Bituminous [13] ... do	359,368,022	628,383,000	372,373,122	658,063,000	434,070,000	768,000,000
Pennsylvania anthracite ... do	57,168,291	244,152,245	52,158,783	210,130,565	54,760,000	226,000,000
Coke [4] ... do	31,821,576	[4] 159,425,674	35,141,261	[4] 176,853,135	46,275,184	[4] 232,373,991
Diatomite and tripoli [14] ... do	20,529	329,356	27,375	383,416	28,487	391,878
Emery ... do	189	1,800	176	1,606	325	2,900
Feldspar (crude) ... long tons	154,188	853,136	189,550	1,005,021	244,726	1,303,090
Fluorspar ... short tons	85,786	1,391,405	123,741	1,860,638	176,231	3,111,268
Fuller's earth ... do	220,264	2,085,081	227,745	2,230,229	230,814	2,264,978
Garnet for abrasive purposes ... do	2,591	214,815	3,060	256,520	3,820	315,913
Gems and precious stones		[15]		[15]		[15]
Graphite:						
Amorphous ... short tons	[16]	[16]	[16]	[16]	[16]	[16]
Crystalline ... pounds	[16]	[16]	[16]	[16]	[16]	[16]
Grindstones and pulpstones ... short tons	12,630	463,234	14,587	505,378	13,175	497,997
Gypsum ... do	1,536,170	13,761,977	1,903,880	18,860,348	2,712,510	26,222,377
Helium ... cubic feet	[17]	[17]	[17]	[17]	[17]	[17]

Lime	short tons	2, 397, 087	17, 164, 024	2, 987, 133	21, 748, 655	3, 783, 000	27, 464, 000
Magnesite (crude)	do	100, 973	730, 630	177, 154	1, 192, 052	207, 119	1, 411, 664
Mica:							
Scrap [18]	do	7, 719	99, 791	18, 852	243, 951	20, 955	260, 594
Sheet	pounds	583, 528	90, 268	936, 633	161, 150	1, 319, 233	203, 879
Millstones		----------	10, 101	----------	9, 530	----------	10, 609
Mineral paints:							
Natural pigments [19]	short tons	(19)	(19)	(19)	(19)	(19)	(19)
Zinc and lead pigments [20]	do	114, 661	12, 617, 296	137, 972	13, 828, 447	175, 734	15, 850, 829
Mineral waters	gallons sold	(15)	(15)	(15)	(15)	(15)	(15)
Natural gas	M cubic feet	1, 770, 721, 000	395, 378, 000	1, 916, 595, 000	429, 374, 000	2, 175, 000, 000	480, 500, 000
Natural gasoline	gallons	1, 535, 360, 000	60, 523, 000	1, 651, 986, 000	70, 940, 000	1, 765, 722, 000	81, 750, 000
Oilstones, etc.	short tons	396	94, 419	439	105, 589	752	121, 196
Peat	do	40, 544	214, 185	37, 060	199, 377	46, 126	266, 883
Petroleum	barrels (42 gallons)	908, 065, 000	904, 825, 000	996, 596, 000	961, 440, 000	1, 098, 516, 000	1, 150, 000, 000
Phosphate rock	long tons	2, 834, 523	10, 040, 005	3, 042, 381	10, 951, 723	3, 351, 857	11, 406, 132
Potassium salts	short tons	[21] 114, 122	2, 813, 218	[21] 224, 721	4, 993, 481	[21] 222, 810	6, 969, 190
Pumice	do	56, 169	207, 058	60, 000	247, 076	72, 915	328, 406
Pyrites	long tons	432, 524	1, 216, 363	514, 192	1, 583, 074	547, 236	1, 666, 194
Salt	short tons	7, 612, 074	22, 850, 797	7, 926, 897	21, 837, 911	8, 828, 936	23, 306, 177
Sand and gravel:							
Glass sand	do	1, 923, 614	3, 326, 538	2, 125, 761	3, 735, 343	2, 440, 000	4, 150, 000
Sand (molding, building, etc.) and gravel	do	114, 688, 075	57, 920, 635	121, 798, 162	58, 242, 036	170, 220, 000	84, 597, 000
Sand-lime brick [12]	thousands	41, 408	355, 560	61, 757	554, 631	(12)	(12)
Silica (quartz)	short tons	18, 293	129, 965	17, 178	111, 784	12, 986	96, 592
Slate	do	232, 730	2, 707, 928	330, 200	3, 649, 515	452, 400	5, 485, 208
Stone [22]	do	92, 063, 830	98, 979, 936	83, 159, 050	87, 824, 497	122, 433, 000	129, 276, 000
Sulphur	long tons	1, 613, 838	28, 900, 000	1, 634, 990	29, 300, 000	1, 968, 820	35, 400, 000
Sulphuric acid (60° Baumé) from copper and zinc smelters and roasters	short tons	575, 660	4, 227, 096	603, 627	4, 547, 769	(23)	(23)
Talc and ground soapstone [22]	do	138, 505	1, 448, 685	172, 716	1, 848, 055	211, 055	2, 309, 941
Total value of nonmetallic products (approximate)		----------	2, 770, 600, 000	----------	2, 910, 900, 000	----------	3, 496, 000, 000

[4] Value not included in total value.
[5] Value included in total value of metallic products; Bureau of Mines not at liberty to publish figures.
[6] Product from domestic ores only.
[12] Figures obtained through cooperation with Bureau of the Census. Figures for 1936 not yet available; estimate of value included in total value of nonmetallic products.
[13] Includes brown coal and lignite, and anthracite mined elsewhere than in Pennsylvania.
[14] Figures represent tripoli only. Value of diatomite included in total value of nonmetallic products; Bureau of Mines not at liberty to publish figures.
[15] No canvass. Estimate of value included in total value of nonmetallic products.
[16] Value included in total value of nonmetallic products; Bureau of Mines not at liberty to publish figures.
[17] Value included in total value of nonmetallic products. For details of production in fiscal years see chapter of this volume on Helium.
[18] 1934: Figures include fine mica recovered as byproduct in washing kaolin but do not include mica obtained by grinding mica schists; mica schists are included as "micaceous minerals" under last item ("Unspecified"). 1935–36: Figures include mica recovered from kaolin and mica schists. See chapter of this volume on Mica.
[19] Canvass discontinued after 1915. Value of iron ore sold for paint included under last item ("Unspecified").
[20] Sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide.
[21] Equivalent as K_2O.
[22] Figures for soapstone used as dimension stone included in figures for stone.
[23] Figures not yet available; estimate of value included in total value of nonmetallic products.

Mineral products of the United States, 1934–36—Continued

Product	1934		1935		1936	
	Quantity	Value	Quantity	Value	Quantity	Value
SUMMARY						
Total value of metallic products		$540,300,000		$723,800,000		$1,064,000,000
Total value of nonmetallic products (exclusive of mineral fuels)		537,200,000		580,900,000		789,700,000
Total value of mineral fuels		2,233,400,000		2,330,000,000		2,706,300,000
Total value of "unspecified" (metallic and nonmetallic) products (partly estimated) [24]		[24] 14,500,000		[24] 15,300,000		[24] 22,000,000
Grand total approximate value of mineral products		3,325,400,000		3,650,000,000		4,582,000,000

[24] Includes value of following products. Figures are shown wherever Bureau of Mines is at liberty to publish them.

1934: Bismuth, cadmium compounds, chats ($518,110), flint lining for tube mills, iodine ($342,957), iron ore sold for magnets, iron ore sold for paint ($26,151), lithium minerals ($20,980), new ingot magnesium, natural magnesium hydrate (brucite), natural magnesium salts ($1,266,325), calcareous marl ($22,236), greensand marl ($209,278), micaceous minerals (mica schists and vermiculite) ($123,796), molybdenum ($6,502,000), pebbles for grinding, selenium, silica sand and sandstone (finely ground) ($1,301,285), sodium salts (carbonates and sulphates) from natural sources ($1,402,338), tantalum ore ($968), tellurium, and an estimate of the value of miscellaneous mineral products for which statistics are not collected annually by the Bureau of Mines.

1935: Bismuth, cadmium compounds, chats ($386,840), flint lining for tube mills, optical fluorspar ($184), iodine ($248,654), iron ore sold for paint ($28,683), lithium minerals ($26,834), new ingot magnesium, natural magnesium salts ($1,286,804), calcareous marl ($94,658), greensand marl ($219,749), micaceous minerals (vermiculite) ($88,445), molybdenum ($7,261,000), pebbles for grinding, selenium, silica sand and sandstone (finely ground) ($1,564,300), sodium salts (carbonates and sulphates) from natural sources ($1.448,946), tantalum ore ($4,521), tellurium, and an estimate of the value of miscellaneous mineral products for which statistics are not collected annually by the Bureau of Mines.

1936: Bismuth, cadmium compounds ($906,000), chats ($666,000), flint lining for tube mills, iodine ($212,625), iron ore sold for magnets, iron ore sold for paint ($53,037), lithium minerals ($25,273), new ingot magnesium, natural magnesium hydrate (brucite), natural magnesium salts ($1,629,725), calcareous marl ($58,682), greensand marl ($177,835), micaceous minerals (vermiculite) ($184,387), molybdenum ($11,933,000), pebbles for grinding, selenium, silica sand and sandstone (finely ground) ($2,146,464), sodium salts (carbonates and sulphates) from natural sources ($1,442,923), tellurium, and an estimate of the value of miscellaneous mineral products for which statistics are not collected annually by the Bureau of Mines.

Value of mineral products of the United States, 1880–1936

Year	Metallic		Nonmetallic		Unspecified (metallic and nonmetallic)	Total	
	Value	Increase or decrease (percent)	Value	Increase or decrease (percent)		Value	Increase or decrease (percent)
1880	$187,881,000	(1)	$173,582,000	(1)	$6,000,000	$367,463,000	(1)
1881	189,413,000	+0.8	207,207,000	+19	6,500,000	403,120,000	+10
1882	215,820,000	+14	230,786,000	+11	6,500,000	453,106,000	+12
1883	197,881,000	−8	243,680,000	+6	6,500,000	448,061,000	−1
1884	180,284,000	−9	221,756,000	−9	5,000,000	407,040,000	−9
1885	172,218,000	−4	242,333,000	+9	5,000,000	419,551,000	+3
1886	204,400,000	+19	250,995,000	+4	790,000	456,185,000	+9
1887	240,791,000	+18	294,057,000	+17	785,000	535,633,000	+17
1888	242,010,000	+.5	310,889,000	+6	900,000	553,799,000	+3
1889	250,325,000	+3	291,004,000	−6	997,000	542,326,000	−2
1890	303,440,000	+21	310,995,000	+7	994,000	615,429,000	+13
1891	280,485,000	−8	319,364,000	+3	1,000,000	600,849,000	−2
1892	283,715,000	+1	337,517,000	+6	1,000,000	622,232,000	+4
1893	223,154,000	−21	321,339,000	−5	1,000,000	545,493,000	−12
1894	186,835,000	−16	362,410,000	+13	1,000,000	550,245,000	+.9
1895	248,033,000	+33	393,658,000	+9	1,000,000	642,691,000	+17
1896	252,075,000	+2	387,966,000	−1	1,000,000	641,041,000	−.3
1897	269,934,000	+7	380,678,000	−2	1,000,000	651,612,000	+2
1898	308,247,000	+14	417,795,000	+10	1,000,000	727,042,000	+12
1899	483,521,000	+57	525,575,000	+26	1,000,000	1,010,096,000	+39
1900	513,732,000	+6	594,204,000	+13	1,000,000	1,108,936,000	+10
1901	493,314,000	−4	660,764,000	+11	1,000,000	1,155,078,000	+4
1902	604,517,000	+23	722,434,000	+9	1,000,000	1,327,951,000	+15
1903	588,753,000	−3	905,628,000	+25	1,000,000	1,495,381,000	+13
1904	501,114,000	−15	857,667,000	−5	400,000	1,359,181,000	−9
1905	702,585,000	+40	920,780,000	+7	400,000	1,623,765,000	+19
1906	886,180,000	+26	1,014,500,000	+10	200,000	1,900,880,000	+17
1907	904,108,000	+2	1,165,376,000	+15	86,000	2,069,570,000	+9
1908	550,768,000	−39	1,040,761,000	−11	244,000	1,591,773,000	−23
1909	754,944,000	+37	1,131,866,000	+9	297,000	1,887,107,000	+19
1910	749,879,000	−.7	1,237,668,000	+9	297,000	1,987,844,000	+5
1911	680,907,000	−9	1,242,942,000	+.4	232,000	1,924,081,000	−3
1912	862,008,000	+27	1,375,420,000	+11	366,000	2,237,794,000	+16
1913	878,869,000	+2	1,554,298,000	+13	378,000	2,433,545,000	+9
1914	686,639,000	−22	1,424,063,000	−8	470,000	2,111,172,000	−13
1915	991,730,000	+44	1,400,484,000	−2	2,430,000	2,394,644,000	+13
1916	1,620,745,000	+63	1,884,413,000	+35	3,281,000	3,508,439,000	+47
1917	2,086,234,000	+29	2,900,462,000	+54	5,800,000	4,992,496,000	+42
1918	2,153,318,000	+3	3,380,690,000	+17	6,700,000	5,540,708,000	+11
1919	1,359,744,000	−37	3,232,626,000	−4	3,400,000	4,595,770,000	−17
1920	1,762,350,000	+30	5,214,170,000	+61	4,820,000	6,981,340,000	+52
1921	654,130,000	−63	3,481,720,000	−33	2,650,000	4,138,500,000	−41
1922	987,180,000	+51	3,656,410,000	+5	3,700,000	4,647,290,000	+12
1923	1,510,930,000	+53	4,471,620,000	+22	3,950,000	5,986,500,000	+29
1924	1,232,330,000	−18	4,067,730,000	−9	5,740,000	5,305,800,000	−11
1925	1,380,280,000	+12	4,291,100,000	+5	6,250,000	5,677,630,000	+7
1926	1,402,920,000	+2	4,803,080,000	+12	7,600,000	6,213,600,000	+9
1927	1,217,700,000	−13	4,304,100,000	−10	8,200,000	5,530,000,000	−11
1928	1,284,580,000	+5	4,091,620,000	−5	9,000,000	5,385,200,000	−3
1929	1,475,990,000	+15	4,401,180,000	+8	10,430,000	5,887,600,000	+9
1930	982,550,000	−33	3,773,400,000	−14	8,850,000	4,764,800,000	−19
1931	567,200,000	−42	2,592,100,000	−31	7,300,000	3,166,600,000	−34
1932	283,700,000	−50	2,172,000,000	−16	6,000,000	2,461,700,000	−22
1933	411,300,000	+45	2,132,900,000	−2	10,900,000	2,555,100,000	+4
1934	540,300,000	+31	2,770,600,000	+30	14,500,000	3,325,400,000	+30
1935	723,800,000	+34	2,910,900,000	+5	15,300,000	3,650,000,000	+10
1936 [2]	1,064,000,000	+47	3,496,000,000	+20	22,000,000	4,582,000,000	+26
Grand total	40,971,790,000		97,501,262,000		225,137,000	138,698,189,000	

[1] Figures for earlier years not available.
[2] Subject to revision.

The sum of the following State totals does not reach the total for the United States given in the preceding table partly because figures for certain of the products included in the United States total are not available by States of origin. This fact is brought out in the opening text of this chapter and in the second table following.

In addition, there are many factors (the more important discussed in the opening text) that account for the disagreement between the sum of the State totals and the grand total for the United States, by products. Chief among these are: (1) The use of iron ore values in State totals and pig iron values in United States total; (2) the use of mine figures for gold, silver, copper, lead, and zinc in the State totals and mint and smelter figures (supplemented by the value of byproduct sulphuric acid from copper and zinc smelting and zinc roasting and the value of zinc and lead pigments made in large part direct from ores) in the United States total; and (3) the inclusion of estimates in the United States total for a few products for which no canvass has been conducted for many years and for which no estimate by States is made.

Many other less important differences are involved, but both State and United States totals are as complete and definite as seems possible with the data available. The practice is consistent from year to year, and it is believed that the reader can determine readily just what minerals are covered by the total concerned.

In every table each mineral produced is listed, and all figures are shown except those that the Bureau of Mines is not at liberty to publish.

Value of mineral products of the United States, 1931–35, by States [1]

State	1931	1932	1933	1934	1935
Alabama	$38,506,558	$19,170,152	$23,291,204	$29,827,048	$31,772,042
Alaska	12,371,057	11,526,387	12,681,071	19,578,971	18,811,544
Arizona	41,602,929	15,203,724	12,570,753	26,062,865	38,848,203
Arkansas	18,692,379	15,540,325	12,710,203	16,081,642	17,608,569
California	304,538,557	286,683,332	293,034,859	331,255,652	360,178,680
Colorado	32,970,230	25,800,227	27,259,095	39,473,123	44,413,477
Connecticut	4,299,790	1,910,803	1,550,594	2,276,061	2,656,207
Delaware	394,579	300,426	135,397	271,814	229,904
District of Columbia	281,980	1,819,017	423,233	406,891	479,256
Florida	10,850,806	7,107,866	8,843,896	11,548,144	11,447,052
Georgia	10,290,593	6,292,609	6,111,641	6,365,165	7,440,226
Idaho	13,177,427	9,477,884	12,429,155	16,708,153	21,364,029
Illinois	108,065,936	71,692,511	74,837,452	89,211,596	96,483,558
Indiana	50,852,088	34,602,723	34,010,753	39,416,727	42,512,613
Iowa	21,614,611	18,522,625	15,154,652	19,326,181	21,709,817
Kansas	56,804,312	58,471,164	57,974,881	81,117,503	96,905,947
Kentucky	74,868,106	59,076,459	65,536,454	89,042,117	98,486,090
Louisiana	61,692,802	61,097,004	54,886,010	85,210,783	107,544,710
Maine	4,889,282	3,174,278	2,593,871	2,352,076	2,559,648
Maryland	11,330,323	7,233,821	7,014,570	10,128,349	10,035,751
Massachusetts	11,170,497	8,038,615	4,917,110	6,165,303	5,650,148
Michigan	62,785,908	34,713,951	54,222,848	61,831,364	77,149,256
Minnesota	55,275,230	12,272,622	42,472,038	48,330,235	57,313,256
Mississippi	2,387,771	2,718,919	2,765,988	2,520,521	3,092,609
Missouri	41,805,772	29,245,055	30,588,018	32,954,534	35,800,213
Montana	32,359,904	19,023,093	21,662,089	31,430,496	52,096,553
Nebraska	3,623,426	1,548,486	2,047,335	2,790,571	3,228,856
Nevada	14,963,785	6,568,283	7,455,493	14,702,869	20,987,749
New Hampshire	2,796,132	1,351,554	1,457,041	1,149,289	693,988
New Jersey	41,632,683	23,073,173	22,580,043	25,009,596	28,514,673
New Mexico	25,349,712	20,263,883	23,354,681	30,079,469	33,502,362
New York	78,007,467	50,175,726	42,940,471	54,625,552	58,408,999
North Carolina	5,554,190	2,466,311	3,365,160	5,342,306	6,774,649
North Dakota	2,271,454	2,385,735	2,960,811	2,549,850	2,543,910
Ohio	130,927,783	87,996,538	91,145,609	117,504,662	126,133,670
Oklahoma	181,904,857	185,120,909	172,560,924	237,208,583	251,700,898
Oregon	5,045,307	2,989,383	3,504,825	4,211,397	5,596,484
Pennsylvania	594,642,786	424,734,073	421,846,539	546,932,552	520,575,611
Rhode Island	792,911	506,325	386,983	485,441	570,520
South Carolina	3,031,459	950,693	1,014,162	1,323,293	1,843,476
South Dakota	11,338,739	11,118,029	14,658,504	19,173,033	22,209,554
Tennessee	24,461,447	14,561,792	16,785,481	23,525,650	25,743,471
Texas	302,201,046	390,141,325	365,571,179	509,521,286	528,069,238
Utah	40,301,788	22,620,230	24,179,771	32,527,119	41,881,265
Vermont	8,421,911	6,401,143	5,792,574	4,852,949	5,097,295
Virginia	26,150,041	16,927,446	18,845,740	28,309,377	30,923,115
Washington	14,800,608	12,816,678	9,387,645	12,944,751	13,688,083
West Virginia	221,734,789	156,643,214	172,726,695	241,473,621	245,402,124
Wisconsin	11,843,343	7,414,456	7,153,881	9,752,431	11,815,933
Wyoming	30,892,663	27,343,288	22,025,393	27,640,294	30,669,658

[1] In this table iron ore, not pig iron, is taken as the basis of iron valuation, and for other metals mine production (recoverable content of metals) is the basis. State totals for 1936 not yet available.

Mineral products of the United States and principal producing States in 1935

Rank in value	Product	Principal producing States[1]: In order of quantity	Principal producing States[1]: In order of value
20	Aluminum	New York, Tennessee, North Carolina	Rank same as for quantity.
(2)	Antimonial lead	Not separable by States	Not separable by States.
81	Antimony ore	Idaho, Nevada	Rank same as for quantity.
58	Arsenious oxide	Montana, Utah, Idaho	Do.
63	Asbestos	Vermont, Arizona, Montana, Maryland	Vermont, Arizona, Maryland, Montana.
	Asphalt:		
37	Native	Oklahoma, Texas, Kentucky, Alabama	Utah, Kentucky, Oklahoma, Texas.
19	Oil	Not separable by States	Not separable by States.
49	Barite (crude)	Missouri, California, Georgia, Tennessee	Missouri, Georgia, California, Tennessee.
43	Bauxite	Arkansas, Alabama, Georgia	Rank same as for quantity.
54	Bismuth	Not separable by States	Not separable by States.
30	Borates	California	Rank same as for quantity.
29	Briquets, fuel	Wisconsin, Pennsylvania, West Virginia, Oregon	Wisconsin, Pennsylvania, Oregon, West Virginia.
34	Bromine	Michigan, North Carolina, California, West Virginia	Rank same as for quantity.
35	Cadmium (metal and compounds)	Not separable by States	Not separable by States.
51	Calcium-magnesium chloride	Michigan, West Virginia, Ohio, California	Rank same as for quantity.
8	Cement	Pennsylvania, California, New York, Michigan	Pennsylvania, California, New York, Texas.
61	Chats	Missouri, Oklahoma, Kansas	Rank same as for quantity.
86	Chromite	California	Do.
	Clay:		
6	Products		Ohio, Pennsylvania, West Virginia, New Jersey.
26	Raw	Pennsylvania, Georgia, Ohio, Missouri	Georgia, Pennsylvania, Missouri, South Carolina.
2	Coal:		
	Bituminous	West Virginia, Pennsylvania, Illinois, Kentucky	Pennsylvania, West Virginia, Illinois, Kentucky.
	Pennsylvania anthracite	Pennsylvania	Rank same as for quantity.
5	Coke	Pennsylvania, Ohio, New York, Indiana	Pennsylvania, Indiana, New York, Ohio.
12	Copper	Arizona, Montana, Utah, Nevada	Rank same as for quantity.
45	Diatomite	California, Oregon, New Jersey, New York	California, New Jersey, Oregon, New York.
89	Emery	New York	Rank same as for quantity.
52	Feldspar (crude)	North Carolina, Colorado, South Dakota, Maine	North Carolina, New Hampshire, Maine, Virginia.
14	Ferro-alloys	Pennsylvania, New York, Ohio, West Virginia	Pennsylvania, New York, West Virginia, Ohio.
85	Flint lining for tube mills	Minnesota	Rank same as for quantity.
39	Fluorspar	Kentucky, Illinois, Colorado, New Mexico	Do.
36	Fuller's earth	Georgia, Florida, Texas, Illinois	Florida, Georgia, Texas, Illinois.
64	Garnet, abrasive	New York, New Hampshire	Rank same as for quantity.
(3)	Gems and precious stones	No canvass for 1935	No canvass for 1935.
7	Gold	California, South Dakota, Alaska, Colorado	Rank same as for quantity.
84	Graphite:		
	Amorphous	Nevada	Do.
	Crystalline	California, Montana	Do.
57	Grindstones and pulpstones	Ohio, West Virginia, Washington	Do.
23	Gypsum	New York, Michigan, Iowa, Texas	Do.
74	Helium	Texas	Do.

65	Iodine (natural)	California	Do.
	Iron:		
10	Ore	Minnesota, Michigan, Alabama, Pennsylvania	Minnesota, Michigan, Alabama, Wisconsin.
4	Pig	Ohio, Pennsylvania, Illinois, Indiana	Pennsylvania, Ohio, Illinois, Indiana.
(4)	Kyanite	No figures available	No figures available.
18	Lead	Missouri, Idaho, Utah, Oklahoma	Rank same as for quantity.
22	Lime	Ohio, Pennsylvania, Missouri, West Virginia	Do.
82	Lithium minerals	South Dakota	Do.
50	Magnesite	Washington, California	Do.
53	Magnesium	Michigan	Do.
47	Magnesium salts (natural)	Michigan, Oklahoma, California, Washington	Michigan, California, Oklahoma, Washington.
55	Manganese ore	Montana, Georgia, Arkansas, Virginia	Rank same as for quantity.
46	Manganiferous ore	Minnesota, Montana, Wisconsin, Michigan	Minnesota, Montana, Wisconsin, Georgia.
67	Manganiferous zinc residuum	New Jersey	Rank same as for quantity.
	Marl:		
75	Calcareous	Wisconsin, West Virginia, Virginia, Minnesota	Wisconsin, West Virginia, Ohio, Virginia.
68	Greensand	New Jersey	Rank same as for quantity.
48	Mercury	California, Texas, Oregon, Arkansas	Do.
59	Mica	North Carolina, Georgia, New Mexico, Virginia	North Carolina, Connecticut, Georgia, New Mexico.
	Scrap	do	Rank same as for quantity.
	Sheet	North Carolina, Connecticut, New Hampshire, Colorado	Do.
76	Micaceous minerals (vermiculite)	Montana, Wyoming	Do.
83	Millstones		New York, Virginia, North Carolina.
24	Mineral paints, zinc and lead pigments	Pennsylvania, Ohio, Kansas, Indiana	Rank same as for quantity.
(3)	Mineral waters	No canvass for 1935	No canvass for 1935.
27	Molybdenum	Colorado, Arizona, New Mexico, Nevada	Rank same as for quantity.
3	Natural gas	Texas, California, Oklahoma, Louisiana	Texas, California, Louisiana, West Virginia.
11	Natural gasoline	California, Texas, Oklahoma, Louisiana	California, Texas, Oklahoma, West Virginia.
71	Nickel	Not separable by States	Not separable by States.
73	Oilstones, etc	Ohio, Vermont, Arkansas, Indiana	Arkansas, Ohio, Indiana, Vermont.
(5)	Ores (crude), etc.:		
	Copper	Utah, Arizona, Nevada, Michigan	Value not available.
	Copper-lead	Montana, Colorado, New Mexico, Nevada	Do.
	Dry and siliceous (gold and silver)	Alaska, California, Colorado, South Dakota	Do.
	Lead	Missouri, Idaho, Utah, Nevada	Do.
	Lead-zinc	Oklahoma, Kansas, Idaho, Utah	Do.
	Zinc	Oklahoma, Kansas, Tennessee, New Jersey	Do.
69	Peat	New York, New Jersey, Michigan, California	New Jersey, New York, Ohio, Florida.
88	Pebbles for grinding	Minnesota, California	Rank same as for quantity.
1	Petroleum	Texas, California, Oklahoma, Kansas	Texas, Oklahoma, California, Kansas.
25	Phosphate rock	Florida, Tennessee, Idaho, Montana	Rank same as for quantity.
44	Platinum and allied metals	Alaska, California, Oregon, Nevada	Do.
31	Potassium salts	New Mexico, California, Maryland, Utah	California, New Mexico, Maryland, Wyoming.
66	Pumice	Kansas, California, Nebraska, Oklahoma	Rank same as for quantity.
41	Pyrites	Tennessee, Virginia, California, New York	Do.
21	Salt	Michigan, New York, Ohio, Louisiana	Do.

[1] Rank of States in metal production (except aluminum, ferro-alloys, and pig iron) arranged according to mine reports, not smelter output.
[2] Separate figures for antimonial lead from primary sources not available.
[3] No canvass for 1935.
[4] No figures available.
[5] Value not available.

Mineral products of the United States and principal producing States in 1935—Continued

Rank in value	Product	Principal producing States: In order of quantity	Principal producing States: In order of value
13	Sand and gravel	New York, Illinois, Montana, California	New York, Pennsylvania, Illinois, California.
56	Sand-lime brick	New York, Michigan, Massachusetts, Minnesota	Rank same as for quantity.
60	Selenium	Not separable by States	Not separable by States.
72	Silica (quartz)	Ohio, Missouri, New Jersey, Tennessee	New Jersey, Missouri, Ohio, Tennessee.
42	Silica sand and sandstone (finely ground)	New Jersey, Illinois, Wisconsin, Pennsylvania	New Jersey, Illinois, Wisconsin, Ohio.
16	Silver	Idaho, Montana, Utah, Arizona	Rank same as for quantity.
33	Slate		Pennsylvania, Vermont, New York, Maine.
28	Sodium salts (other than NaCl) from natural sources.	California, Texas, Wyoming, Nevada	Rank same as for quantity.
9	Stone	Pennsylvania, Michigan, New York, Ohio	Pennsylvania, New York, Ohio, Michigan.
17	Sulphur	Texas, Louisiana, California, Utah	Rank same as for quantity.
32	Sulphuric acid from copper and zinc smelters and roasters.	Pennsylvania, Illinois, Tennessee, Oklahoma	Do.
40	Talc and ground soapstone [6]	New York, Vermont, California, North Carolina	Do.
87	Tantalum ore	South Dakota	Do.
80	Tellurium	Not separable by States	Not separable by States.
79	Tin	Alaska, South Dakota	Rank same as for quantity.
	Titanium ore:		
77	Ilmenite	Virginia	Do.
70	Rutile	Virginia, Arkansas	Do.
62	Tripoli	Missouri, Illinois, Arkansas, Oklahoma	Missouri, Illinois, Oklahoma, Arkansas.
38	Tungsten ore	Nevada, Arizona, Colorado, California	Nevada, Arizona, Colorado, Washington
78	Uranium and vanadium ores	Arizona, Colorado, Utah	Colorado, Utah, Arizona
15	Zinc	Oklahoma, New Jersey, Montana, Kansas	Rank same as for quantity.

[6] Exclusive of soapstone used as dimension stone (all from Virginia), which is included in figures for stone.

States and their principal mineral products in 1935 [1]

State	Rank	Principal mineral products in order of value
Alabama	21	Coal, iron ore, cement, clay products.
Alaska	30	Gold, copper, coal, platinum and allied metals.
Arizona	18	Copper, gold, silver, molybdenum.
Arkansas	31	Petroleum, coal, bauxite, natural gas.
California	3	Petroleum, natural gas. gold, natural gasoline.
Colorado	15	Coal, gold, molybdenum, silver.
Connecticut	43	Stone, clay products, sand and gravel, lime.
Delaware	50	Clay products, stone, sand and gravel.
District of Columbia	49	Clay products, stone.
Florida	34	Phosphate rock, stone, cement, fuller's earth.
Georgia	36	Stone, clay products, cement, fuller's earth.
Idaho	28	Silver, lead, gold, zinc.
Illinois	10	Coal, clay products, petroleum, cement.
Indiana	16	Coal, cement, clay products, stone.
Iowa	27	Coal, cement, gypsum, clay products.
Kansas	9	Petroleum, natural gas, coal, zinc.
Kentucky	8	Coal, natural gas, petroleum, clay products.
Louisiana	7	Petroleum, natural gas, sulphur, salt.
Maine	44	Stone, cement, clay products, sand and gravel.
Maryland	35	Coal, clay products, sand and gravel, cement.
Massachusetts	38	Stone, clay products, sand and gravel, lime.
Michigan	11	Iron ore, petroleum, cement, salt.
Minnesota	13	Iron ore, sand and gravel, cement, manganiferous ore.
Mississippi	42	Natural gas, clay products, sand and gravel, petroleum.
Missouri	19	Lead, clay products. coal, cement.
Montana	14	Copper, silver, petroleum, natural gas.
Nebraska	41	Cement, sand and gravel, clay products, stone.
Nevada	29	Gold, copper, silver, zinc.
New Hampshire	47	Clay products, stone, sand and gravel, feldspar.
New Jersey	24	Clay products, zinc, sand and gravel, stone.
New Mexico	20	Petroleum, natural gas, coal, potassium salts.
New York	12	Petroleum, stone, clay products, cement.
North Carolina	37	Clay products, stone, bromine, feldspar.
North Dakota	45	Coal, clay products, sand and gravel, stone.
Ohio	6	Clay products, coal, natural gas, petroleum.
Oklahoma	4	Petroleum, natural gas, natural gasoline, zinc.
Oregon	39	Gold, cement, stone, sand and gravel.
Pennsylvania	2	Coal, natural gas, petroleum, cement.
Rhode Island	48	Stone, sand and gravel, lime, clay products.
South Carolina	46	Stone, clay products, sand and gravel, gold.
South Dakota	26	Gold, sand and gravel, cement, stone.
Tennessee	25	Coal, cement, stone, phosphate rock.
Texas	1	Petroleum, natural gas, sulphur, natural gasoline.
Utah	17	Copper, silver, gold, coal.
Vermont	40	Stone, slate, talc, lime.
Virginia	22	Coal, stone, zinc, clay products.
Washington	32	Coal, stone, cement, sand and gravel.
West Virginia	5	Coal, natural gas, clay products, petroleum.
Wisconsin	33	Stone, clay products, sand and gravel, iron ore.
Wyoming	23	Petroleum, coal, natural gas, natural gasoline.

[1] In this table iron ore, not pig iron, is taken as the basis of iron valuation, and for other metals mine production (recoverable content of metals) is the basis.

Prices of gold, silver, copper, lead, and zinc, 1932–36

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[4] $20.67+	$0.282	$0.063	$0.030	$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[5] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050

[1] 1932: Legal coinage value; 1933–34: Yearly average weighted Government price; 1935–36: Price under authority of Gold Reserve Act of Jan. 31, 1934.
[2] 1932–33: Average New York price for bar silver; 1934: Treasury buying price for newly mined silver; 1935–36: Yearly average weighted Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $20.671835.
[5] $0.64646464.

STATE TABLES

Mineral production of Alabama, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Asphalt (native) short tons	(1)	(1)	(1)	(1)
Bauxite long tons	(1)	(1)	(1)	(1)
Cement barrels	[2] 2,181,513	[2] $3,017,329	[2] 2,483,616	[2] $3,521,418
Clay:				
Products		(1 3)		[3] 1,543,050
Raw short tons	36,572	[4] 46,426	46,026	[4] 63,042
Coal do	9,142,117	18,838,000	8,504,510	18,251,000
Coke do	2,109,192	[4] 6,508,933	1,994,220	[4] 6,388,066
Copper pounds	11,000	880	10,061	835
Ferro-alloys long tons	26,140	[4] 1,612,178	19,907	[4] 876,762
Fuller's earth short tons	(1)	(1)		
Gold [5] troy ounces	2,781	97,186	2,227	77,953
Graphite, crystalline pounds	(1)	(1)		
Iron:				
Ore long tons	2,720,923	4,379,827	3,559,934	5,826,711
Pig do	1,144,900	[4] 15,805,365	1,324,942	[4] 19,437,381
Lime short tons	123,881	746,232	127,157	803,186
Manganese ore long tons			185	4,595
Manganiferous ore do	1,404	7,878	647	6,226
Mica, sheet pounds			(1)	(1)
Mineral waters gallons sold	(6)	(6)	(6)	(6)
Ore (dry and siliceous) (gold and silver) short tons	22,511	(7)	15,067	(7)
Sand and gravel do	660,633	348,978	572,953	241,947
Silver troy ounces	361	233	401	288
Stone short tons	[8] 542,500	[8] 660,458	639,700	764,027
Miscellaneous [9]		1,730,047		730,806
Total value, eliminating duplications		29,827,048		31,772,042

[1] Value included under "Miscellaneous."
[2] Exclusive of puzzolan, value for which is included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Value not included in total value for State.
[5] Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Exclusive of sandstone, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "1", "2", and "8" above.

Mineral production of Alaska, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Arsenic short tons	(1)	(1)	(1)	(1)
Coal do	107,508	$451,000	119,425	$502,000
Copper pounds	114,000	9,120	15,500,000	1,286,500
Gold [2] troy ounces	537,282	18,778,000	469,495	16,432,325
Lead short tons	747	55,241	670	53,600
Ores (crude), etc.:				
Copper do			44,655	(3)
Dry and siliceous (gold and silver) do	4,390,000	(3)	3,833,338	(3)
Lead do			22	(3)
Platinum and allied metals troy ounces	1,873	73,297	6,448	234,392
Sand and gravel short tons	(4)	(4)	(4)	(4)
Silver troy ounces	168,868	109,167	286,848	206,172
Stone short tons	48,890	74,919	(4)	(4)
Tin (metallic equivalent) do	9	(4)	49	49,800
Miscellaneous [5]		28,227		46,755
Total value, eliminating duplications		19,578,971		18,811,544

[1] Figures not available.
[2] Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
[3] Not valued as ore; value of recoverable metal content included under the metals.
[4] Value included under "Miscellaneous."
[5] Includes minerals indicated by "4" above.

Mineral production of Arizona, 1934–35

Product	1934 Quantity	1934 Value	1935 Quantity	1935 Value
Asbestos short tons	(1)	(1)	(1)	(1)
Clay:				
Products		(1, 2)		[2] $103,330
Raw short tons	(1, 3)	(1, 3)	(1, 3)	(1, 3)
Coal do	9,058	$45,000	(1)	(1)
Copper pounds	178,082,213	14,246,577	278,029,289	23,076,431
Diatomite short tons	(1)	(1)		
Feldspar (crude) long tons	(1)	(1)	(1)	(1)
Gems and precious stones		(4)		(4)
Gold [5] troy ounces	167,024	5,837,493	241,755	8,461,411
Gypsum short tons	765	15,413	(1)	(1)
Lead do	3,439	254,457	7,783	622,644
Lime do	16,003	163,748	22,048	227,658
Mercury flasks (76 pounds)	(1)	(1)	(1)	(1)
Mica, scrap short tons	(6)	(6)	(1, 7)	(1, 7)
Micaceous minerals (mica schist) do	140	742	(8)	(8)
Molybdenum pounds	378,730	(1)	966,088	(1)
Ores (crude), etc.:				
Copper short tons	2,845,604	(9)	6,011,755	(9)
Copper-lead do	47	(9)	4	(9)
Dry and siliceous (gold and silver) do	373,073	(9)	604,644	(9)
Lead do	16,203	(9)	16,749	(9)
Lead-zinc do	35,315	(9)	129,772	(9)
Zinc do			7,126	(9)
Sand and gravel do	4,152,689	1,730,874	(1)	(1)
Sand-lime brick thousands			(1, 2)	(1, 2)
Silica (quartz) short tons	(1)	(1)	(1)	(1)
Silver troy ounces	4,448,474	2,875,781	6,601,280	4,744,670
Stone short tons	392,250	346,975	192,390	182,638
Sulphuric acid [10] do	(1, 3)	(1, 3)	(1, 3)	(1, 3)
Tungsten ore (60 percent concentrates) do	(1)	(1)	394	(1)
Vanadium ores do	(1)	(1)	(1)	(1)
Zinc do	905	77,842	3,337	293,653
Miscellaneous [11]		659,418		1,393,652
Total value, eliminating duplications		26,062,865		38,848,203

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
[6] Reported as mica schist.
[7] From ground mica schist.
[8] Reported as scrap mica from ground mica schist.
[9] Not valued as ore; value of recoverable metal content included under the metals.
[10] From copper smelting.
[11] Includes minerals indicated by "1" above.

Mineral production of Arkansas, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Bauxite .... long tons	145,764	$1,057,062	219,791	$1,465,302
Briquets, fuel .... short tons			([1] [2])	([1] [2])
Cement .... barrels	([1])	([1])	([1])	([1])
Clay:				
Products		[3] 349,154		[3] 569,579
Raw .... short tons			531	[2] 3,151
Coal .... do	856,432	2,564,000	1,133,279	3,448,000
Gems and precious stones		([4])		([4])
Iron ore sold for magnets .... long tons	5	([1])		
Lead .... short tons	40	2,960	38	3,040
Lime .... do	([1])	([1])	([1])	([1])
Manganese ore .... long tons	5,842	([1])	3,809	([1])
Manganiferous ore .... do	1,374	([1])	145	([1])
Mercury .... flasks (76 pounds)	488	36,046	304	21,885
Mineral waters .... gallons sold	([4])	([4])	([4])	([4])
Natural gas .... M cubic feet	7,024,000	1,574,000	6,167,000	1,400,000
Natural gasoline .... gallons	13,033,000	450,000	13,076,000	570,000
Oilstones .... short tons	82	49,741	93	64,651
Ores (crude), etc.:				
Lead .... do	([5])	([6])	[7] 950	([6])
Zinc .... do	([5])	([6])	[7] 3,900	([6])
Petroleum .... barrels	11,182,000	8,000,000	11,008,000	7,930,000
Sand and gravel .... short tons	1,122,099	565,190	1,189,420	512,010
Slate		([1])		([1])
Stone .... short tons	[8] 397,150	[8] 268,667	335,360	351,531
Talc .... do			17	82
Titanium minerals: Rutile .... do	([1])	([1])	([1])	([1])
Tripoli .... do	1,968	21,774	2,021	22,231
Zinc .... do	68	5,848	153	13,464
Miscellaneous [9]		1,137,200		1,248,802
Total value, eliminating duplications		16,081,642		17,608,569

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Figures not available.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Estimate.
[8] Exclusive of sandstone, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "1" and "8" above.

Mineral production of California, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Asphalt (native) .... short tons	(1)	(1)	(1)	(1)
Barite .... do	21, 783	$124, 664	29, 683	$172, 034
Borates .... do	242, 500	4, 822, 014	272, 967	5, 381, 560
Briquets, fuel .... do	(1 2)	(1 2)	(1 2)	(1 2)
Bromine .... pounds	(1)	(1)	(1)	(1)
Calcium chloride .... short tons	(1)	(1)	(1)	(1)
Cement .... barrels	8, 395, 037	12, 449, 389	8, 137, 880	11, 174, 973
Chromite .... long tons	369	4, 653	515	6, 163
Clay:				
Products		[3] 5, 475, 818		[3] 9, 287, 971
Raw .... short tons	205, 934	[2] 500, 796	200, 508	[2] 528, 531
Coal .... do	(1)	(1)	(1)	(1)
Copper .... pounds	569, 068	45, 525	1, 954, 000	162, 182
Diatomite .... short tons	(1)	(1)	(1)	(1)
Feldspar (crude) .... long tons	(1)	(1)	3, 015	21, 105
Ferro-alloys .... do			(1 2)	(1 2)
Fluorspar .... short tons	181	(1)		
Gems and precious stones		(4)		(4)
Gold [5] .... troy ounces	719, 064	25, 131, 284	890, 430	31, 165, 050
Graphite, crystalline .... pounds			(1)	(1)
Gypsum .... short tons	55, 620	(1)	70, 408	(1)
Iodine .... pounds	284, 604	342, 957	245, 696	248, 654
Iron ore .... long tons	16, 333	(1)	18, 734	(1)
Lead .... short tons	412	30, 457	567	45, 360
Lime .... do	34, 733	342, 621	49, 141	491, 549
Magnesite .... do	(1)	(1)	(1)	(1)
Magnesium salts (natural) .... pounds	(1)	(1)	(1)	(1)
Manganese ore .... long tons	158	1, 500	306	(1)
Mercury .... flasks (76 pounds)	7, 808	576, 738	9, 271	667, 419
Mica, scrap .... short tons	(6)	(6)	[7] 263	[7] 2, 703
Micaceous minerals (mica schist) .... do	320	2, 240	(8)	(8)
Mineral plants, zinc and lead pigments .... do	(1 2)	(1 2)	(1 2)	(1 2)
Mineral waters .... gallons sold	(4)	(4)	(4)	(4)
Natural gas .... M cubic feet	268, 122, 000	73, 055, 000	284, 109, 000	81, 485, 000
Natural gasoline .... gallons	506, 272, 000	29, 931, 000	534, 624, 000	29, 778, 000
Ores (crude), etc.:				
Copper .... short tons	53, 357	(9)	94, 577	(9)
Copper-lead .... do	11	(9)	120	(9)
Dry and siliceous (gold and silver) .... do	2, 209, 699	(9)	3, 237, 926	(9)
Lead .... do	2, 160	(9)	1, 471	(9)
Lead-zinc .... do			3, 300	(9)
Zinc .... do	864	(9)	379	(9)
Peat .... short tons	(1)	(1)	2, 962	16, 935
Pebbles for grinding .... do	(1)	(1)	(1)	(1)
Petroleum .... barrels	174, 305, 000	160, 760, 000	207, 832, 000	170, 600, 000
Platinum and allied metals .... troy ounces	312	12, 223	195	7, 081
Potassium salts .... short tons	(1)	(1)	(1)	(1)
Pumice .... do	9, 431	60, 088	12, 059	92, 789
Pyrites .... long tons	(1)	(1)	(1)	(1)
Salt .... short tons	341, 893	2, 026, 376	356, 222	2, 182, 643
Sand and gravel .... do	6, 811, 109	4, 147, 509	6, 890, 719	4, 119, 402
Sand and sandstone (finely ground) .... do	(1)	(1)	(1)	(1)
Silica (quartz) .... do	(1)	(1)	650	2, 600
Silver .... troy ounces	844, 413	545, 883	1, 191, 112	856, 112
Slate		35, 393		42, 660
Sodium salts (carbonates and sulphates) from natural sources .... short tons	91, 439	1, 274, 701	117, 915	1, 299, 330
Stone .... do	5, 597, 040	5, 520, 311	4, 178, 380	4, 169, 031
Sulphur .... long tons	3, 989	78, 070	(1)	(1)
Sulphuric acid [10] .... short tons			(1 2)	(1 2)
Talc and ground soapstone .... do	15, 880	164, 777	21, 464	290, 439
Tripoli .... do	(1)	(1)	(1)	(1)
Tungsten ore (60 percent concentrates) .... do	(1)	(1)	(1)	(1)
Zinc .... do	361	31, 034	161	14, 168
Miscellaneous [11]		4, 348, 414		6, 540, 904
Total value, eliminating duplications		331, 255, 652		360, 178, 680

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
[6] Reported as mica schist.
[7] From ground mica schist.
[8] Reported as scrap mica from ground mica schist.
[9] Not valued as ore; value of recoverable metal content included under the metals.
[10] From zinc-roasting operation.
[11] Includes minerals indicated by "1" above.

Mineral production of Florida, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products		[2] $117,802		[2] $62,171
Raw ... short tons	(1 3)	(1 3)	(1 3)	(1 3)
Fuller's earth ... do	(1)	(1)	(1)	(1)
Lime ... do	14,207	121,247	13,572	126,035
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Peat ... short tons	(1)	(1)	(1)	(1)
Phosphate rock ... long tons	2,369,334	8,076,317	2,422,804	8,377,609
Sand and gravel ... short tons	402,981	269,938	385,711	233,029
Sand-lime brick ... thousands	(1 2)	(1 2)	(1 2)	(1 2)
Stone ... short tons	[5] 1,095,800	[5] 945,515	[5] 1,216,390	[5] 1,021,497
Miscellaneous [6]		2,183,636		1,855,803
Total value, eliminating duplications		11,548,144		11,447,052

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral production of Georgia, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Barite ... short tons	(1)	(1)	30,577	$178,254
Bauxite ... long tons	(1)	(1)	(1)	(1)
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products		(1 2)		[2] 2,143,631
Raw ... short tons	284,556	[3] $1,621,223	353,633	[3] 2,363,729
Coal ... do	32,716	80,000	(1)	(1)
Fuller's earth ... do	(1)	(1)	(1)	(1)
Gold [4] ... troy ounces	970	33,898	994	34,782
Iron ore ... long tons	1,098	1,845	2,949	7,685
Kyanite ... short tons	(5)	(5)	(5)	(5)
Lime ... do	2,664	21,674	5,192	40,689
Manganese ore ... long tons	6,281	(1)	6,960	95,683
Manganiferous ore ... do	9,197	(1)	3,735	23,722
Mica:				
Scrap ... short tons	(1)	(1)	(1 6)	(1 6)
Sheet ... pounds	(1)	(1)	(1)	(1)
Micaceous minerals (chlorite schist) ... short tons	(1)	(1)	(7)	(7)
Mineral waters ... gallons sold	(8)	(8)	(8)	(8)
Ore (dry and siliceous) (gold and silver) ... short tons	2,069	(9)	1,200	(9)
Sand and gravel ... do	325,526	229,849	364,507	240,565
Silver ... troy ounces	48	31	74	53
Slate		(1)		(1)
Stone ... short tons	953,050	2,526,786	1,198,610	2,650,556
Talc ... do	(1)	(1)	(1)	(1)
Tripoli ... do	(1)	(1)	(1)	(1)
Miscellaneous [10]		3,471,082		2,024,606
Total value, eliminating duplications		6,365,165		7,440,226

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
[5] Figures not available.
[6] Includes mica from ground mica schist.
[7] Reported as scrap mica from ground mica schist.
[8] No canvass.
[9] Not valued as ore; value of recoverable metal content included under the metals.
[10] Includes minerals indicated by "1" above.

Mineral production of Idaho, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Antimony ore (concentrates) short tons	897	(1)	3,602	(1)
Arsenious oxide do	961	$49,042	415	$16,294
Cement barrels	(1)	(1)	(1)	(1)
Clay:				
Products		(1 2)		(1 2)
Raw short tons	282	[3] 3,655	(1 3)	(1 3)
Coal do	(1)	(1)	(1)	(1)
Copper pounds	1,531,625	122,530	2,095,867	173,957
Gems and precious stones		(4)		(4)
Gold [5] troy ounces	84,817	2,964,361	83,823	2,933,807
Iron ore long tons			41	(1)
Lead short tons	71,324	5,277,984	79,020	6,321,610
Lime do	(1)	(1)	(1)	(1)
Ores (crude), etc.:				
Copper do	1,020	(6)	243	(6)
Copper-lead do	118,927	(6)		
Dry and siliceous (gold and silver) do	202,784	(6)	443,951	(6)
Lead do	240,465	(6)	256,077	(6)
Lead-zinc do	723,986	(6)	820,674	(6)
Phosphate rock long tons	37,151	140,397	41,796	176,877
Sand and gravel short tons	632,485	237,896	972,743	584,953
Silver troy ounces	7,394,143	4,780,052	10,240,953	7,360,685
Stone short tons	[7] 764,730	[7] 575,103	[7] 686,480	[7] 631,050
Tungsten ore (60 percent concentrates) do	1	(1)		
Zinc do	24,799	2,132,742	31,053	2,732,645
Miscellaneous [8]		428,046		435,626
Total value, eliminating duplications		16,708,153		21,364,029

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of sandstone, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "1" and "7" above.

Mineral production of Illinois, 1934–35

Product	1934 Quantity	1934 Value	1935 Quantity	1935 Value
Cement ... barrels	[1] 3,908,107	[1] $5,498,568	[1] 3,276,970	[1] $4,500,897
Clay:				
Products		[2] 4,930,454		(2 3)
Raw ... short tons	69,921	[4] 160,537	98,912	[4] 281,352
Coal ... do	41,272,384	64,238,000	44,525,469	69,516,000
Coke ... do	1,649,907	[4] 9,071,800	1,668,523	[4] 9,628,162
Fluorspar ... do	33,234	567,396	44,120	685,794
Fuller's earth ... do	(3)	(3)	(3)	(3)
Iron, pig ... long tons	1,430,841	[4] 25,357,717	2,224,132	[4] 39,092,488
Lead ... short tons	40	2,960	436	34,880
Lime ... do	86,679	655,359	117,602	878,746
Mineral paints, zinc and lead pigments ... do	11,043	[4] 1,217,607	12,417	[4] 1,224,407
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)
Natural gas ... M cubic feet	1,868,000	1,290,000	1,448,000	844,000
Natural gasoline ... gallons	3,810,000	183,000	2,642,000	141,000
Ore (lead and zinc) ... short tons	(6)	(6)	(6)	(6)
Peat ... do	(3)	(3)	(3)	(3)
Petroleum ... barrels	4,479,000	4,990,000	4,322,000	4,810,000
Pyrites ... long tons			9,091	(3)
Sand and gravel ... short tons	6,174,202	3,373,690	8,354,473	4,276,342
Sand and sandstone (finely ground) ... do	38,610	200,893	51,364	269,690
Sand-lime brick ... thousands			(2 3)	(2 3)
Silver ... troy ounces	310	200	3,147	2,262
Stone ... short tons	3,915,880	2,894,538	[7] 4,405,750	[7] 3,230,188
Sulphuric acid (60° Baumé) [8] ... do	123,701	[4] 977,238	137,389	[4] 1,163,685
Tripoli ... do	7,417	119,418	10,001	113,484
Miscellaneous [9]		267,120		7,180.275
Total value, eliminating duplications		89,211,596		96.483,558

[1] Exclusive of natural cement, value for which is included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value included under "Miscellaneous."
[4] Value not included in total value for State.
[5] No canvass.
[6] No ore milled in Northern Illinois; lead output of Southern Illinois is byproduct of fluorspar milling.
[7] Exclusive of unclassified stone, value for which is included under "Miscellaneous"
[8] From zinc smelting.
[9] Includes minerals indicated by "1", "3", and "7" above.

Mineral production of Indiana, 1934–35

Product	1934 Quantity	1934 Value	1935 Quantity	1935 Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products		[2] $3,336,038		[2] $4,928,742
Raw ... short tons	67,245	[3] 78,129	66,808	[3] 80,911
Coal ... do	14,793,643	21,838,000	15,754,214	23.722,000
Coke ... do	2,613,437	[3] 16,957,287	3,768,480	[3] 25,484,234
Fuller's earth ... do	(1)	(1)	(1)	(1)
Iron, pig ... long tons	1,545,011	[3] 27,187,989	2,182,798	[3] 38,809,232
Lime ... short tons	72,606	443,398	71,883	442,803
Mineral paints, zinc and lead pigments ... do	(1 3)	(1 3)	(1 3)	(1 3)
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Natural gas ... M cubic feet	1,802,000	1,060,000	1,777,000	1,081,000
Peat ... short tons	(1)	(1)	(1)	(1)
Petroleum ... barrels	838,000	960,000	777,000	880,000
Rubbing stones and whetstones ... short tons	62	8,861	(1)	(1)
Sand and gravel ... do	3,957,548	1,890,185	4,450,885	2,293,749
Sand-lime brick ... thousands	(1 2)	(1 2)	(1 2)	(1 2)
Stone ... short tons	[5] 2,057,440	[5] 4,140,960	[5] 1,826,830	[5] 3,024.414
Miscellaneous [6]		7,412,872		7,708,268
Total value, eliminating duplications		39,416,727		42.512,613

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral production of Iowa, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Cement ... barrels	3, 340, 049	$5, 094, 922	3, 203, 301	$5, 072, 098
Clay:				
Products		[1] 1, 352, 227		[1] 2, 006, 021
Raw ... short tons	2, 272	[2] 22, 242	3, 275	[2] 33, 547
Coal ... do	3, 366, 992	7, 862, 000	3, 650, 163	9, 002, 000
Ferro-alloys ... long tons	(2 3)	(2 3)	(2 3)	(2 3)
Gypsum ... short tons	180, 271	1, 670, 356	230, 203	2, 215, 770
Iron, pig ... long tons	(2 3)	(2 3)	5, 425	(2 3)
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Peat ... short tons	(3)	(3)	(3)	(3)
Sand and gravel ... do	4, 348, 862	1, 393, 800	5, 732, 742	1, 756, 851
Stone ... do	[5] 2, 276, 440	[5] 1, 934, 364	1, 840, 080	1, 645, 937
Miscellaneous [6]		1, 320, 509		1, 714, 363
Total value, eliminating duplications		19, 326, 181		21, 709, 817

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value not included in total value for State.
[3] Value included under "Miscellaneous."
[4] No canvass.
[5] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "3" and "5" above.

Mineral production of Kansas, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Ashphalt (native) ... short tons	(1)	(1)	(1)	(1)
Cement ... barrels	[2] 2, 425, 867	[2] $3, 734, 493	[2] 2, 487, 888	[2] $3, 778, 104
Chats ... short tons	87, 000	13, 200	(3)	(3)
Clay products		[4] 656, 510		(1 4)
Coal ... short tons	2, 508, 254	4, 619, 000	2, 686, 164	4, 943, 000
Gypsum ... do	68, 655	383, 910	92, 619	523, 188
Lead ... do	6, 805	503, 570	10, 892	871, 360
Mineral paints, zinc and lead pigments ... do	(1 5)	(1 5)	(1 5)	(1 5)
Mineral waters ... gallons sold	(6)	(6)	(6)	(6)
Natural gas ... M cubic feet	46, 909, 000	14, 124, 000	57, 125, 000	18, 153, 000
Natural gasoline ... gallons	27, 891, 000	796, 000	32, 507, 000	1, 145, 000
Ores (crude), etc.:				
Lead ... short tons	2, 000	(7)		
Lead-zinc ... do	1, 159, 600	(7)	1, 337, 400	(7)
Zinc ... do	935, 100	(7)	1, 562, 700	(7)
Petroleum ... barrels	46, 482, 000	47, 850, 000	54, 843, 000	56, 750, 000
Pumice ... short tons	39, 283	102, 668	41, 111	108, 349
Pyrites ... long tons			(1)	(1)
Salt ... short tons	768, 133	2, 949, 930	608, 204	2, 309, 482
Sand and gravel ... do	1, 681, 619	698, 461	1, 570, 975	666, 529
Stone ... do	[8] 1, 371, 300	[8] 1, 350, 391	[8] 1, 852, 170	[8] 1, 833, 763
Zinc ... do	38, 261	3, 290, 446	54, 110	4, 761, 680
Miscellaneous [9]		1, 605, 819		3, 086, 330
Total value, eliminating duplications		81, 117, 503		96, 905, 947

[1] Value included under "Miscellaneous."
[2] Exclusive of natural cement, value for which is included under "Miscellaneous."
[3] Figures not available.
[4] Figures obtained through cooperation with Bureau of the Census.
[5] Value not included in total value for State.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "1", "2", and "8" above.

Mineral production of Kentucky, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Asphalt (native) ... short tons	(1)	(1)	(1)	(1)
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products	...	(1 2)	...	[2] $3,884,049
Raw ... short tons	140,842	[3] $606,703	232,797	[3] 781,210
Coal ... do	38,525,235	60,548,000	40,760,939	65,956,000
Coke ... do	(1 3)	(1 3)	(1 3)	(1 3)
Fluorspar ... do	43,163	690,990	68,679	1,017,451
Iron, pig ... long tons	170,399	(1 3)	213,837	(1 3)
Lead ... short tons	104	7,696	132	10,560
Lime ... do	(1)	(1)	(1)	(1)
Marl, calcareous ... do	(1)	(1)	...	...
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Natural gas ... M cubic feet	33,124,000	14,973,000	39,738,000	17,730,000
Natural gasoline ... gallons	4,171,000	177,000	5,614,000	287,000
Ores (lead and zinc) ... short tons	(5)	(5)	(5)	(5)
Petroleum ... barrels	4,860,000	5,640,000	5,258,000	6,000,000
Sand and gravel ... short tons	1,069,656	789,748	856,381	550,569
Stone ... do	1,992,820	1,760,756	[6] 1,956,810	[6] 1,709,330
Zinc ... do	125	10,750	127	11,176
Miscellaneous [7]	...	8,743,200	...	6,755,036
Total value, eliminating duplications	...	89,042,117	...	98,486,090

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Figures not available.
[6] Exclusive of sandstone, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "1" and "6" above.

Mineral production of Louisiana, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay products	...	[2] $63,463	...	[2] $176,352
Lime ... short tons	(1)	(1)	(1)	(1)
Mineral waters ... gallons sold	(3)	(3)	(3)	(3)
Natural gas ... M cubic feet	225,713,000	42,531,000	249,450,000	46,468,000
Natural gasoline ... gallons	40,558,000	1,141,000	49,732,000	1,871,000
Petroleum ... barrels	32,869,000	31,850,000	50,330,000	49,820,000
Salt ... short tons	567,289	2,854,785	702,990	2,514,896
Sand and gravel ... do	1,090,331	646,883	1,359,567	869,140
Stone ... do	(1)	(1)	(1)	(1)
Sulphur ... long tons	307,186	5,350,487	275,747	4,867,988
Miscellaneous [4]	...	773,165	...	957,334
Total value, eliminating duplications	...	85,210,783	...	107,544,710

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] No canvass.
[4] Includes minerals indicated by "1" above.

Mineral production of Maine, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Cement....barrels..	(1)	(1)	(1)	(1)
Clay:				
Products....		[2] $226,952		[2] $314,313
Raw....short tons.	(1 3)	(1 3)	(1 3)	(1 3)
Feldspar (crude)....long tons..	14,685	82,854	17,103	99,770
Gems and precious stones....		(4)		(4)
Lime....short tons..	(1)	(1)	(1)	(1)
Mica:				
Scrap....do....			70	980
Sheet....pounds..	(1)	(1)		
Mineral waters....gallons sold..	(4)	(4)	(4)	(4)
Peat....short tons..	(1)	(1)	(1)	(1)
Sand and gravel....do....	2,030,222	238,761	2,326,814	256,365
Slate....		133,835		221,799
Stone....short tons..	[5] 138,620	[5] 949,632	[5] 151,660	[5] 968,675
Miscellaneous [6]....		720,065		697,752
Total value, eliminating duplications....		2,352,076		2,559,648

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Exclusive of basalt in 1934 and of unclassified stone in 1935, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral production of Maryland, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Asbestos....short tons..	(1)	(1)	(1)	(1)
Cement....barrels..	(1)	(1)	(1)	(1)
Clay:				
Products....		[2] $1,807,667		[2] $2,466,470
Raw....short tons..	22,700	[3] 78,604	17,048	[3] 94,625
Coal....do....	1,627,112	3,089,000	1,678,059	3,266,000
Coke....do....	784,539	(1 3)	929,617	(1 3)
Feldspar (crude)....long tons..	(1)	(1)	(1)	(1)
Iron, pig....do....	704,304	(1 3)	863,861	(1 3)
Lime....short tons..	28,167	191,071	39,528	300,021
Marl, calcareous....do....	(1)	(1)	(1)	(1)
Mineral waters....gallons sold..	(4)	(4)	(4)	(4)
Potassium salts....short tons..	(1)	(1)	(1)	(1)
Sand and gravel....do....	1,693,112	1,708,519	1,483,386	1,434,761
Silica (quartz)....do....	564	6,390	405	6,075
Slate....		(1)		(1)
Stone....short tons..	[5] 897,830	[5] 1,127,798	[5] 623,770	[5] 829,915
Talc....do....	(1)	(1)	(1)	(1)
Miscellaneous [6]....		18,167,128		18,694,318
Total value, eliminating duplications....		10,128,349		10,035,751

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Exclusive of marble, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral production of Massachusetts, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Briquets, fuel ... short tons	([1,2])	([1,2])	([1,2])	([1,2])
Clay:				
Products		[3] $806,201		[3] $883,797
Raw ... short tons	1,014	[2] 12,761	753	[2] 8,868
Coke ... do	1,127,632	[2] 7,181,783	1,006,115	[2] 6,048,544
Iron, pig ... long tons	([1,2])	([1,2])	([1,2])	([1,2])
Lime ... short tons	52,518	452,494	67,969	642,755
Mineral waters ... gallons sold	([4])	([4])	([4])	([4])
Peat ... short tons	([1])	([1])	([1])	([1])
Sand and gravel ... do	2,033,201	1,109,066	1,876,660	831,103
Sand and sandstone (finely ground) ... do	514	3,471	995	5,723
Sand-lime brick ... thousands	([1,3])	([1,3])	([1,3])	([1,3])
Stone ... short tons	2,347,080	3,743,875	[5] 1,848,740	[5] 3,204,858
Miscellaneous [6]		781,728		530,357
Total value, eliminating duplications		6,165,303		5,650,148

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Exclusive of marble, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral production of Michigan, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Bromine ... pounds	([1])	([1])	([1])	([1])
Calcium chloride ... short tons	([1])	([1])	([1])	([1])
Cement ... barrels	3,945,375	$5,920,214	4,325,134	$5,971,720
Clay:				
Products		[2] 3,224,189		([1,2])
Raw ... short tons	([1,3])	([1,3])	([1,3])	([1,3])
Coal ... do	621,741	1,940,000	628,384	2,017,000
Coke ... do	2,547,747	[3] 14,348,536	2,482,302	[3] 14,125,590
Copper ... pounds	48,215,859	3,857,269	64,108,689	5,321,021
Gems and precious stones		([4])		([4])
Gold [5] ... troy ounces	59	2,049		
Gypsum ... short tons	281,033	2,469,222	342,989	3,315,222
Iron:				
Ore—				
Sold to furnaces ... long tons	5,497,953	15,646,165	7,235,698	20,788,153
Sold for paint ... do	1,165	([1])	401	([1])
Pig ... do	644,895	[3] 9,987,451	781,458	[3] 12,225,499
Lime ... short tons	32,844	240,181	35,401	260,097
Magnesium ... pounds	4,249,838	([1])	4,241,218	([1])
Magnesium chloride (natural) ... do	([1])	([1])	([1])	([1])
Magnesium sulphate (natural) ... do	([1])	([1])	([1])	([1])
Manganiferous ore ... long tons	595	([1])	5,402	16,140
Marl, calcareous ... short tons	([1])	([1])	([1])	([1])
Mineral waters ... gallons sold	([4])	([4])	([4])	([4])
Natural gas ... M cubic feet	2,789,000	1,421,000	4,203,000	1,973,000
Natural gasoline ... gallons	589,000	15,000	1,850,000	71,000
Ores (crude), etc.:				
Copper ... short tons	700,055	([6])	1,376,803	([6])
Dry and siliceous (gold and silver) ... do	800	([6])		
Peat ... do	([1])	([1])	5,000	10,997
Petroleum ... barrels	10,603,000	10,820,000	15,776,000	16,350,000
Salt ... short tons	2,012,370	5,470,684	2,128,171	5,337,536
Sand and gravel ... do	5,432,071	2,197,838	6,591,748	2,794,031
Sand-lime brick ... thousands	[2] 5,575	[2] 45,129	[2] 10,684	[2] 91,409
Silver ... troy ounces	529	342	4,219	3,032
Stone ... short tons	[7] 6,617,770	[7] 3,718,398	[7] 8,230,930	[7] 4,315,462
Talc ... do	([1])	([1])		
Miscellaneous [8]		4,844,306		8,513,965
Total value, eliminating duplications		61,831,364		77,149,256

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Gold valued at $34.95 per ounce.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of sandstone, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "1" and "7" above.

Mineral production of Minnesota, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Briquets, fuel ... short tons			(1 2)	(1 2)
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products		3 $703, 616		(1 3)
Raw ... short tons	(1 2)	(1 2)	3, 220	3 $7, 594
Coke ... do	417, 447	(1 2)	430, 082	(1 2)
Flint lining for tube mills ... do	(1)	(1)	(1)	(1)
Gems and precious stones		(4)		(4)
Iron:				
Ore—				
Sold to furnaces ... long tons	15, 768, 418	41, 843, 148	20, 035, 653	50, 260, 668
Sold for paint ... do	774	(1)	1, 250	(1)
Pig ... do	(1 2)	(1 2)	(1 2)	(1 2)
Lime ... short tons	(1)	(1)	(1)	(1)
Manganiferous ore ... long tons	197, 622	510, 017	497, 304	1, 199, 358
Marl, calcareous ... short tons			2, 600	1, 900
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Peat ... short tons	(1)	(1)	(1)	(1)
Pebbles for grinding ... do	(1)	(1)	(1)	(1)
Sand and gravel ... do	5, 217, 775	2, 064, 876	6, 166, 064	2, 169, 332
Sand-lime brick ... thousands	3 6, 899	3 49, 510	(1 3)	(1 3)
Stone ... short tons	797, 510	1, 925, 753	529, 670	1, 123, 061
Miscellaneous 5		4, 559, 648		6, 246, 508
Total value, eliminating duplications		48, 330, 235		57, 313, 256

1 Value included under "Miscellaneous."
2 Value not included in total value for State.
3 Figures obtained through cooperation with Bureau of the Census.
4 No canvass.
5 Includes minerals indicated by "1" above.

Mineral production of Mississippi, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Clay:				
Products		(1 2)		2 $450, 505
Raw ... short tons	(1 3)	(1 3)		
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Natural gas ... M cubic feet	8, 245, 000	$2, 021, 000	9, 643, 000	2, 259, 000
Petroleum ... barrels	(1)	(1)	2, 000	1, 000
Sand and gravel ... short tons	677, 828	349, 800	924, 406	381, 799
Stone ... do	(1)	(1)	(1)	(1)
Miscellaneous		150, 921		305
Total value, eliminating duplications		2, 520, 521		3, 092, 609

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 Value not included in total value for State.
4 No canvass.

Mineral production of Missouri, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Asphalt (native)....short tons..	(1)	(1)	(1)	(1)
Barite....do....	118,836	$581,889	131,921	$727,888
Briquets, fuel....do....	(1 2)	(1 2)	(1 2)	(1 2)
Cement....barrels..	3,779,125	5,449,606	3,291,332	4,940,713
Chats....short tons..	1,937,000	484,350	1,496,700	243,250
Clay:				
Products....	....	[3] 6,323,896	....	[3] 7,443,931
Raw....short tons..	223,022	[2] 961,854	268,358	[2] 1,006,862
Coal....do....	3,352,283	6,278,000	3,645,996	6,924,000
Coke....do....	(1 2)	(1 2)	(1 2)	(1 2)
Copper....pounds..	46,276	3,702	67,660	5,616
Iron ore....long tons..	4,154	13,271	2,069	8,764
Lead....short tons..	90,493	6,696,482	97,493	7,799,440
Lime....do....	272,236	1,538,900	312,462	1,759,918
Mineral paints, zinc, and lead pigments....do....	....	....	(1 2)	(1 2)
Mineral waters....gallons sold..	(4)	(4)	(4)	(4)
Natural gas....M cubic feet..	549,000	278,000	609,000	282,000
Ores (crude), etc.:				
Lead....short tons..	2,989,700	(5)	3,083,700	(5)
Lead-zinc....do....	60,700	(5)	185,100	(5)
Zinc....do....	364,600	(5)	367,800	(5)
Petroleum....barrels..	35,000	29,000	45,000	40,000
Pyrites....long tons..	14,557	51,640	24,883	77,263
Sand and gravel....short tons..	2,381,453	1,462,740	3,109,104	1,889,787
Sand-lime brick....thousands..	(1 3)	(1 3)	....	....
Silica (quartz)....short tons..	(1)	(1)	(1)	(1)
Silver....troy ounces..	63,066	40,770	110,551	79,459
Stone....short tons..	[6] 2,438,260	[6] 2,913,415	2,263,350	2,695,352
Tripoli....do....	(1)	(1)	(1)	(1)
Zinc....do....	7,059	607,074	7,263	639,144
Miscellaneous [7]....	....	1,247,281	....	1,444,849
Total value, eliminating duplications....	....	32,954,534	....	35,800,213

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "1" and "6" above.

Mineral production of Montana, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Arsenious oxide .... short tons..	6,833	$348,704	8,154	$320,148
Asbestos .... do....	8	240	94	2,500
Cement .... barrels..	(1)	(1)	(1)	(1)
Clay:				
Products	....	[2] 98,593	....	(1 2)
Raw .... short tons..	2,675	[3] 4,800	11,344	[3] 11,291
Coal .... do....	2,565,702	3,997,000	2,758,906	4,146,000
Copper .... pounds..	63,265,000	5,061,200	154,957,470	12,861,470
Gems and precious stones	....	(4)	....	(4)
Gold [5] .... troy ounces..	97,446	3,405,736	151,088	5,288,081
Graphite, crystalline .... pounds..	(1)	(1)	(1)	(1)
Gypsum .... short tons..	(1)	(1)	(1)	(1)
Lead .... do....	10,005	740,370	15,589	1,247,101
Lime .... do....	(1)	(1)	(1)	(1)
Manganese ore .... long tons..	11,548	362,450	10,823	340,002
Manganiferous ore .... do....	11,247	43,484	6,818	32,077
Micaceous minerals (vermiculite) .... short tons..	(1)	(1)	6,868	85,920
Mineral waters .... gallons sold..	(4)	(4)	(4)	(4)
Natural gas .... M cubic feet..	14,971,000	4,415,000	19,870,000	5,587,000
Natural gasoline .... gallons..	1,237,000	83,000	1,739,000	151,000
Ores (crude), etc.:				
Copper .... short tons..	458,587	(6)	1,259,892	(6)
Copper-lead .... do....	....	....	308	(6)
Dry and siliceous (gold and silver) .... do....	287,828	(6)	554,853	(6)
Lead .... do....	10,321	(6)	9,085	(6)
Lead-zinc .... do....	244,303	(6)	464,534	(6)
Zinc .... do....	65,913	(6)	123,441	(6)
Petroleum .... barrels..	3,603,000	4,380,000	4,603,000	6,150,000
Phosphate rock .... long tons..	2,086	7,613	27,497	73,701
Pyrites .... do....	(1)	(1)	(1)	(1)
Sand and gravel .... short tons..	5,257,164	2,073,513	7,692,457	2,830,095
Silver .... troy ounces..	4,006,468	2,590,040	9,322,951	6,700,871
Stone .... short tons..	434,260	407,363	[7] 193,430	[7] 190,382
Zinc .... do....	30,721	2,642,017	54,781	4,820,705
Miscellaneous [8]	....	774,173	....	1,269,500
Total value, eliminating duplications		31,430,496	....	52,096,553

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of sandstone, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "[1]" and "[7]" above.

Mineral production of Nebraska, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Briquets, fuel .... short tons..	(1 2)	(1 2)	(1 2)	(1 2)
Cement .... barrels..	(1)	(1)	(1)	(1)
Clay:				
Products	....	(1 3)	....	(1 3)
Raw .... short tons..	9,006	[2] $6,226	10,303	[2] $21,762
Mineral waters .... gallons sold..	(4)	(4)	(4)	(4)
Pumice .... short tons..	(1)	(1)	(1)	(1)
Sand and gravel .... do....	1,433,407	591,513	2,028,637	854,412
Stone .... do....	294,690	402,367	203,210	294,805
Miscellaneous [5]	....	1,828,854	....	2,105,574
Total value, eliminating duplications	....	2,790,571	....	3,228,856

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Includes minerals indicated by "[1]" above.

Mineral production of Nevada, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Antimony ore ... short tons			14	(1)
Barite ... do	(1)	(1)	(1)	(1)
Clay:				
Products		(1 2)		(1 2)
Raw ... short tons			650	[3] $3,896
Copper ... pounds	41,611,119	$3,328,890	74,266,000	6,164,078
Diatomite ... short tons	(1)	(1)	(1)	(1)
Feldspar (crude) ... long tons	(1)	(1)	(1)	(1)
Fluorspar ... short tons	631	(1)	1,040	(1)
Fuller's earth ... do	(1)	(1)	(1)	(1)
Gems and precious stones		(4)		(4)
Gold [5] ... troy ounces	144,275	5,042,417	188,031	6,581,085
Graphite, amorphous ... short tons	(1)	(1)	(1)	(1)
Gypsum ... do	82,348	(1)	106,894	(1)
Lead ... do	10,991	813,329	12,676	1,014,080
Lime ... do	(1)	(1)	(1)	(1)
Magnesium hydrate (natural) (brucite) ... do	(1)	(1)		
Marl, calcareous ... do	(1)	(1)		
Mercury ... flasks (76 pounds)	300	22,160	190	13,678
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Molybdenum ... pounds	24,116	(1)	(1)	(1)
Ores (crude), etc.:				
Copper ... short tons	1,819,913	(6)	2,904,641	(6)
Copper-lead ... do	72	(6)	135	(6)
Dry and siliceous (gold and silver) ... do	901,454	(6)	1,263,751	(6)
Lead ... do	24,931	(6)	29,494	(6)
Lead-zinc ... do	153,412	(6)	194,798	(6)
Platinum ... troy ounces			2	65
Salt ... short tons	(1)	(1)	(1)	(1)
Sand and gravel ... do	1,377,496	597,453	1,434,078	667,794
Silver ... troy ounces	3,057,114	1,976,316	4,393,426	3,157,775
Sodium sulphate from natural sources ... short tons	(1)	(1)	214	1,915
Stone ... do	[7] 64,880	[7] 74,219	1,093,240	491,050
Tungsten ore (60 percent concentrates) ... do	1,044	(1)	1,219	(1)
Zinc ... do	13,940	1,198,874	15,536	1,367,168
Miscellaneous [8]		1,649,211		1,529,061
Total value, eliminating duplications		14,702,869		20,987,749

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of basalt, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "1" and "7" above.

Mineral production of New Hampshire, 1934–35

Product	1934 Quantity	1934 Value	1935 Quantity	1935 Value
Clay products		[1] $172, 162		[1] $202, 051
Feldspar (crude) long tons	12, 119	80, 733	15, 490	115, 089
Fluorspar short tons			12	(2)
Garnet, abrasive do	(2)	(2)	(2)	(2)
Mica:				
Scrap do	537	9, 529	394	5, 335
Sheet pounds	161, 430	14, 423	131, 586	13, 727
Mineral waters gallons sold	(3)	(3)	(3)	(3)
Peat short tons	(2)	(2)	(2)	(2)
Sand and gravel do	2, 810, 674	300, 213	1, 675, 569	153, 704
Stone do	50, 670	547, 997	33, 050	188, 016
Miscellaneous [4]		24, 232		16, 066
Total value, eliminating duplications		1, 149, 289		693, 988

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] No canvass.
[4] Includes minerals indicated by "2" above.

Mineral production of New Jersey, 1934–35

Product	1934 Quantity	1934 Value	1935 Quantity	1935 Value
Briquets, fuel short tons	(1 2)	(1 2)		
Cement barrels	(1)	(1)	(1)	(1)
Clay:				
Products		[3] $10,249,477		[3] $13, 372, 926
Raw short tons	68, 791	[2] 289, 541	79, 063	[2] 379, 408
Coke do	910, 121	(1 2)	917, 117	(1 2)
Diatomite do	150	4, 635	(1)	(1)
Ferro-alloys long tons	(1 2)	(1 2)	(1 2)	(1 2)
Fuller's earth short tons			(1)	(1)
Iron ore long tons	145, 326	(1)	82, 714	346, 285
Lime short tons	720	6, 090	5, 515	42, 161
Manganiferous residuum long tons	65, 236	(1)	113, 997	(1)
Marl, greensand short tons	7, 335	209, 278	7, 589	219, 749
Mineral paints, zinc and lead pigments do	(1 2)	(1 2)	(1 2)	(1 2)
Mineral waters gallons sold	(4)	(4)	(4)	(4)
Ore (zinc) short tons	469, 339	(5)	476, 608	(5)
Peat do	(1)	(1)	9, 762	55, 340
Sand and gravel do	2, 312, 794	1, 756, 293	2, 573, 732	1, 960, 986
Sand and sandstone (finely ground) do	64, 467	291, 733	66, 097	308, 170
Sand-lime brick thousands			(1 3)	(1 3)
Silica (quartz) short tons	(1)	(1)	(1)	(1)
Stone do	1, 368, 490	1, 662, 968	[6] 1, 242, 000	[6] 1, 516, 372
Talc do	(1)	(1)	(1)	(1)
Zinc [7] do	76, 553	8, 772, 200	85, 708	9, 404, 881
Miscellaneous [8]		8, 293, 279		7, 291, 959
Total value, eliminating duplications		25, 009, 596		28, 514, 673

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metal.
[6] Exclusive of sandstone, value for which is included under "Miscellaneous."
[7] Value reported for zinc in New Jersey is estimated smelting value of recoverable zinc content of ore after freight, haulage, smelting, and manufacturing charges are added.
[8] Includes minerals indicated by "1" and "6" above.

Mineral production of New Mexico, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Asphalt (native) short tons	(1)	(1)	(1)	(1)
Clay:				
Products		(1 2)		(1 2)
Raw short tons	1,411	3 $6,081	1,760	3 $5,677
Coal do	1,259,323	3,402,000	1,388,877	3,681,000
Copper pounds	23,630,000	1,890,400	4,505,000	373,915
Fluorspar short tons	2,040	(1)	2,726	(1)
Gems and precious stones		(4)		(4)
Gold [5] troy ounces	27,307	954,380	33,435	1,170,225
Lead short tons	9,365	692,973	7,289	583,120
Lime do	(1)	(1)	(1)	(1)
Lithium minerals do	(1)	(1)		
Mica:				
Scrap do	602	7,957	1,820	21,635
Sheet pounds	(1)	(1)	(1)	(1)
Mineral waters gallons sold	(4)	(4)	(4)	(4)
Molybdenum pounds	(1)	(1)	(1)	(1)
Natural gas M cubic feet	24,075,000	3,674,000	27,931,000	4,292,000
Natural gasoline gallons	21,748,000	570,000	19,563,000	699,000
Ores (crude), etc.:				
Copper short tons	1,000,972	(6)	3,275	(6)
Copper-lead do	1,176	(6)	277	(6)
Dry and siliceous (gold and silver) do	55,606	(6)	79,696	(6)
Lead do	807	(6)	493	(6)
Lead-zinc do	272,795	(6)	262,343	(6)
Zinc do	66,353	(6)	94,715	(6)
Petroleum barrels	16,864,000	12,700,000	20,483,000	16,060,000
Potassium salts short tons	(1)	(1)	(1)	(1)
Salt do	(1)	(1)	(1)	(1)
Sand and gravel do	161,325	190,879	156,081	104,113
Silver troy ounces	1,061,775	686,400	1,061,902	763,242
Stone short tons	1,215,940	1,094,609	7 1,171,800	7 890,490
Tantalum ore pounds	2,000	800		
Tungsten ore (60 percent concentrates) short tons	1	(1)		
Zinc do	26,522	2,280,849	22,126	1,947,088
Miscellaneous [8]		1,934,222		2,916,534
Total value, eliminating duplications		30,079,469		33,502,362

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 Value not included in total value for State.
4 No canvass.
5 Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
6 Not valued as ore; value of recoverable metal content included under the metals.
7 Exclusive of sandstone, value for which is included under "Miscellaneous."
8 Includes minerals indicated by "1" and "7" above.

Mineral production of New York, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Aluminum ... pounds	[1,2]	[1,2]	[1,2]	[1,2]
Cement ... barrels	[3] 4,730,257	[3] $7,503,270	[3] 4,240,461	[3] $6,612,399
Clay:				
Products	...	[4] 5,648,493	...	[4] 7,063,916
Raw ... short tons	5,390	[2] 39,067	4,144	[2] 25,508
Coke ... do	4,089,708	[2] 25,283,246	4,099,242	[2] 24,617,112
Diatomite ... do	[1]	[1]	[1]	[1]
Emery ... do	189	1,800	176	1,606
Feldspar (crude) ... long tons	6,262	37,275	5,468	39,904
Ferro-alloys ... do	112,021	[2] 9,166,041	137,632	[2] 12,086,368
Garnet, abrasive ... short tons	[1]	[1]	[1]	[1]
Graphite, artificial ... pounds	[1,2]	[1,2]	[1,2]	[1,2]
Gypsum ... short tons	391,408	3,922,529	485,792	5,377,587
Iron:				
Ore—				
Sold to furnaces ... long tons	235,025	[1]	309,628	1,184,776
Sold for paint ... do	[1]	[1]	[1]	[1]
Pig ... do	961,679	[2] 14,621,274	1,479,921	[2] 23,603,728
Lead ... short tons	[1]	[1]	[1]	[1]
Lime ... do	36,050	300,328	59,110	462,363
Millstones	...	3,381	...	4,645
Mineral waters ... gallons sold	[5]	[5]	[5]	[5]
Natural gas ... M cubic feet	6,278,000	4,408,000	8,288,000	5,909,000
Natural gasoline ... gallons	85,000	5,000	27,000	2,000
Ores (crude), etc.:				
Lead-zinc ... short tons	198,936	[6]	214,448	[6]
Zinc ... do	84,016	[6]	80,731	[6]
Peat ... do	[1]	[1]	10,408	30,688
Petroleum ... barrels	3,804,000	9,340,000	4,236,000	9,080,000
Pyrites ... long tons	31,674	[1]	48,905	[1]
Salt ... short tons	1,866,280	5,263,394	1,927,822	5,331,133
Sand and gravel ... do	7,619,456	4,964,440	10,774,096	5,617,572
Sand-lime brick ... thousands	[1,4]	[1,4]	[1,4]	[1,4]
Silica (quartz) ... short tons	[1]	[1]	[1]	[1]
Silver ... troy ounces	26,406	17,071	21,750	15,633
Slate	...	305,869	...	282,900
Stone ... short tons	8,400,690	8,516,754	[7] 7,732,550	[7] 7,420,225
Talc ... do	57,580	681,184	69,125	817,092
Zinc ... do	23,188	1,994,168	23,720	2,087,360
Miscellaneous [8]	...	9,597,016	...	12,431,800
Total value, eliminating duplications	...	54,625,552	...	58,408,999

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Exclusive of natural cement, value for which is included under "Miscellaneous."
[4] Figures obtained through cooperation with Bureau of the Census.
[5] No canvass.
[6] Not valued as ore: value of recoverable metal content included under the metals.
[7] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "1", "3", and "7" above.

Mineral production of North Carolina, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Aluminum ... pounds	(1 2)	(1 2)	(1 2)	(1 2)
Bromine ... do	(1)	(1)	(1)	(1)
Clay:				
Products		[3] $1,136,115		(1 3)
Raw ... short tons	7,146	[2] 106,742	8,312	[2] $119,272
Coal ... do	3,140	9,000	(1)	(1)
Copper ... pounds	(1)	(1)	(1)	(1)
Feldspar (crude) ... long tons	79,844	465,214	82,499	482,729
Gems and precious stones		(4)		(4)
Gold [5] ... troy ounces	509	17,779	2,176	76,145
Iron ore ... long tons			54	(1)
Kyanite ... short tons	(6)	(6)	(6)	(6)
Lime ... do	(1)	(1)	(1)	(1)
Marl, calcareous ... do	(1)	(1)		
Mica:				
Scrap ... do	4,757	59,496	[7] 11,831	[7] 153,553
Sheet ... pounds	293,381	38,674	512,590	77,598
Micaceous minerals (mica schist) ... short tons	(1)	(1)	(8)	(8)
Millstones		(1)		(1)
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Ores (crude):				
Copper ... short tons	26,100	(9)	26,867	(9)
Dry and siliceous (gold and silver) ... do	670	(9)	10,620	(9)
Sand and gravel ... do	338,381	225,588	815,580	310,291
Silica (quartz) ... do	(1)	(1)	(1)	(1)
Silver ... troy ounces	9,710	6,277	7,584	5,451
Stone ... short tons	1,193,690	1,831,351	1,123,240	1,536,192
Talc ... do	15,367	165,523	20,913	220,074
Miscellaneous [10]		3,455,289		7,461,616
Total value, eliminating duplications		5,342,306		6,774,649

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
[6] Figures not available.
[7] Includes mica from ground mica schist.
[8] Reported as scrap mica from ground mica schist. Figures for vermiculite not available.
[9] Not valued as ore; value of recoverable metal content included under the metals.
[10] Includes minerals indicated by "1" above.

Mineral production of North Dakota, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Briquets, fuel ... short tons	(1 2)	(1 2)	(1 2)	(1 2)
Clay:				
Products		(1 3)		(1 3)
Raw ... short tons	(1 2)	(1 2)	(1 2)	(1 2)
Coal ... do	1,753,888	$2,363,000	1,955,510	$2,395,000
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Sand and gravel ... short tons	1,605,382	130,813	934,387	53,810
Stone ... do	[5] 5,700	[5] 2,132	(1)	(1)
Miscellaneous [6]		155,305		256,145
Total value, eliminating duplications		2,549,850		2,543,910

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Exclusive of granite, value for which is included under "Missellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral production of Ohio, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Briquets, fuel ... short tons	(1 2)	(1 2)		
Bromine ... pounds	(1)	(1)	(1)	(1)
Calcium chloride ... short tons	(1)	(1)	(1)	(1)
Cement ... barrels	[3] 3,674,384	[3] $5,565,525	[3] 3,698,309	[3] $5,306,449
Clay:				
Products		[4] 25,600,605		[4] 35,330,847
Raw ... short tons	204,176	[2] 467,829	317,676	[2] 664,713
Coal ... do	20,690,564	35,291,000	21,153,151	35,111,000
Coke ... do	4,296,338	[2] 19,001,895	5,100,987	[2] 23,088,113
Ferro-alloys ... long tons	58,041	[2] 2,146,286	101,764	[2] 3,984,341
Grindstones and pulpstones ... short tons	8,085	241,682	9,867	300,916
Gypsum ... do	(1)	(1)	(1)	(1)
Iron, pig ... long tons	4,147,116	[2] 68,201,509	5,600,757	[2] 93,530,895
Lime ... short tons	562,041	4,282,510	707,358	5,690,656
Marl, calcareous ... do	(1)	(1)	(1)	(1)
Mineral paints, zinc and lead pigments ... do	(1 2)	(1 2)	(1 2)	(1 2)
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)
Natural gas ... M cubic feet	50,330,000	25,728,000	49,592,900	24,179,000
Natural gasoline ... gallons	5,881,000	289,000	6,232,000	358,000
Peat ... short tons	(1)	(1)	2,550	28,063
Petroleum ... barrels	4,234,000	6,830,000	4,082,000	5,920,000
Rubbing stones, scythestones, and whetstones short tons	129	18,151	180	24,911
Salt ... do	1,432,292	2,721,167	1,487,315	2,697,858
Sand and gravel ... do	5,257,514	4,134,006	5,045,695	3,745,868
Sand and sandstone (finely ground) ... do	(1)	(1)	(1)	(1)
Sand-lime brick ... thousands	(1 4)	(1 4)	(1 4)	(1 4)
Silica (quartz) ... short tons	(1)	(1)	(1)	(1)
Stone ... do	5,974,850	5,490,800	[6] 6,234,840	[6] 5,748,188
Sulphuric acid [7] ... do	(1 2)	(1 2)	(1 2)	(1 2)
Miscellaneous [8]		3,896,339		4,322,893
Total value, eliminating duplications		117,504,662		126,133,670

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Exclusive of natural cement, value for which is included under "Miscellaneous."
[4] Figures obtained through cooperation with Bureau of the Census.
[5] No canvass.
[6] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[7] From zinc-roasting operation.
[8] Includes minerals indicated by "1", "3", and "6" above.

Mineral production of Oklahoma, 1934-

Product	1934 Quantity	1934 Value	1935 Quantity	1935 Value
Asphalt (native)...short tons..	(1)	(1)	(1)	(1)
Briquets, fuel...do....	(1 2)	(1 2)	(1 2)	(1 2)
Bromine...pounds..	(1)	(1)	----------	----------
Calcium chloride...short tons..	(1)	(1)	(1)	(1)
Cement...barrels..	(1)	(1)	(1)	(1)
Chats...short tons..	131,000	$20,560	1,099,600	$143,590
Clay:				
Products...	----------	[3] 196,046	----------	[3] 266,185
Raw...short tons..	8,502	[2] 84,241	6,735	[2] 70,327
Coal...do....	1,208,289	2,846,000	1,229,398	2,879,000
Gypsum...do....	105,620	(1)	125,177	(1)
Lead...do....	16,747	1,239,278	23,405	1,872,400
Magnesium sulphate (natural)...pounds..	(1)	(1)	(1)	(1)
Mineral waters...gallons sold..	(4)	(4)	(4)	(4)
Natural gas...M cubic feet..	254,457,000	23,744,000	274,313,000	26,541,000
Natural gasoline...gallons..	355,438,000	10,728,000	379,913,000	14,593,000
Ores (crude), etc.:				
Lead-zinc...short tons..	2,505,200	(5)	2,757,200	(5)
Zinc...do....	3,422,200	(5)	4,490,100	(5)
Petroleum...barrels..	180,107,000	183,700,000	185,288,000	189,000,000
Potassium salts...short tons..	(1)	(1)	(1)	(1)
Pumice...do....	(1)	(1)	(1)	(1)
Salt...do....	(1)	(1)	(1)	(1)
Sand and gravel...do....	703,789	343,704	1,178,262	335,373
Stone...do....	966,020	731,675	734,690	652,366
Sulphuric acid [6]...do....	(1 2)	(1 2)	(1 2)	(1 2)
Tripoli...do....	(1)	(1)	(1)	(1)
Zinc...do....	107,772	9,268,392	129,763	11,419,144
Miscellaneous [7]...	----------	4,881,601	----------	4,502,982
Total value, eliminating duplications...	----------	237,208,583	----------	251,700,898

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] From zinc smelting.
[7] Includes minerals indicated by "1" above.

Mineral production of Oregon, 1934-35

Product	1934 Quantity	1934 Value	1935 Quantity	1935 Value
Briquets, fuel...short tons..	(1 2)	(1 2)	(1 2)	(1 2)
Cement...barrels..	(1)	(1)	(1)	(1)
Clay:				
Products...	----------	[3] $134,715	----------	[3] $289,950
Raw...short tons..	(1 2)	(1 2)	(1 2)	(1 2)
Coal...do....	(1)	(1)	(1)	(1)
Copper...pounds..	38,373	3,070	397,800	33,017
Diatomite...short tons..	(1)	(1)	(1)	(1)
Gems and precious stones...	----------	(4)	----------	(4)
Gold [5]...troy ounces..	33,712	1,178,220	54,160	1,895,604
Lead...short tons..	21	1,539	30	2,383
Lime...do....	(1)	(1)	(1)	(1)
Mercury...flasks (76 pounds)..	3,460	255,573	3,456	248,798
Mineral waters...gallons sold..	(4)	(4)	(4)	(4)
Ores (crude), etc.:				
Copper...short tons..	----------	----------	24	(6)
Dry and siliceous (gold and silver)...do....	61,842	(6)	184,519	(6)
Lead...do....	3	(6)	----------	----------
Lead-zinc...do....	300	(6)	----------	----------
Platinum and allied metals...troy ounces..	113	4,401	103	3,761
Pumice...short tons..	(1)	(1)	(1)	(1)
Sand and gravel...do....	1,617,222	820,077	1,153,885	642,186
Silver...troy ounces..	46,560	30,099	100,385	79,339
Stone...short tons..	[7] 997,030	[7] 863,447	1,204,320	1,017,698
Zinc...do....	37	3,147	----------	----------
Miscellaneous [8]...	----------	1,341,352	----------	1,903,571
Total value, eliminating duplications...	----------	4,211,397	----------	5,596,484

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "1" and "7" above.

Mineral production of Pennsylvania, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Briquets, fuel ... short tons	119,181	[1] $558,615	154,380	[1] $710,544
Cement ... barrels	[2] 15,435,648	[2] 23,138,676	[2] 15,034,441	[2] 21,917,366
Clay:				
Products		[3] 15,530,583		[3] 21,080,596
Raw ... short tons	449,924	[1] 1,126,777	735,200	[1] 1,798,906
Coal:				
Anthracite ... do	57,168,291	244,152,245	52,158,783	210,130,565
Bituminous ... do	89,825,875	165,371,000	91,404,670	172,170,000
Coke ... do	7,554,955	[1] 30,158,115	8,642,227	[1] 34,206,650
Copper [4] ... pounds	(5)	(5)	(5)	(5)
Feldspar (crude) ... long tons	64	456	245	1,847
Ferro-alloys ... do	165,650	[1] 16,375,553	211,947	[1] 21,811,210
Gems and precious stones		(6)		(6)
Gold [4] [7] ... troy ounces	623	21,774	745	26,075
Iron:				
Ore—				
Sold to furnaces ... long tons	524,657	1,052,770	936,421	1,872,842
Sold for paint ... do	640	(5)	(5)	(5)
Pig ... do	4,173,412	[1] 75,383,683	5,549,538	[1] 102,027,692
Lime ... short tons	434,519	3,165,539	531,501	3,703,339
Mineral paints, zinc and lead pigments ... do	(1 5)	(1 5)	(1 5)	(1 5)
Mineral waters ... gallons sold	(6)	(6)	(6)	(6)
Natural gas ... M cubic feet	86,238,000	37,524,000	94,464,000	39,434,000
Natural gasoline ... gallons	10,781,000	467,000	12,623,000	628,000
Peat ... short tons	(5)	(5)	(5)	(5)
Petroleum ... barrels	14,478,000	35,200,000	15,810,000	33,840,000
Sand and gravel ... short tons	5,970,517	5,064,807	4,480,079	4,407,721
Sand and sandstone (finely ground) ... do	(5)	(5)	(5)	(5)
Sand-lime brick ... thousands	(3 5)	(3 5)	(3 5)	(3 5)
Silver [4] ... troy ounces	6,230	4,027	5,843	4,200
Slate		1,237,477		1,800,733
Stone ... short tons	15,251,330	14,501,246	8,570,050	8,895,606
Sulphuric acid (60° Baumé) [8] ... do	161,201	[1] 1,273,488	195,324	[1] 1,654,394
Talc ... do	(5)	(5)	(5)	(5)
Tripoli (rottenstone) ... do	240	4,800	150	4,500
Miscellaneous [9]		6,234,071		7,053,757
Total value, eliminating duplications		546,932,552		520,575,611

[1] Value not included in total value for State.
[2] Exclusive of puzzolan and natural cement in 1934 and of natural cement in 1935, value for which is included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Copper, gold, and silver were recovered from pyritiferous magnetite. The quantity of such ore was 557,740 short tons in 1934 and 1,048,792 short tons in 1935; it is included in the figures shown for iron ore.
[5] Value included under "Miscellaneous."
[6] No canvass.
[7] Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
[8] From zinc smelting.
[9] Includes minerals indicated by "2" and "5" above.

Mineral production of Rhode Island, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Clay products				(1 2)
Coke ... short tons	(1 3)	(1 3)	(1 3)	(1 3)
Lime ... do	1,884	$18,752	(1)	(1)
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Sand and gravel ... short tons	423,624	69,149	376,320	$112,033
Stone ... do	185,280	397,540	[5] 158,480	[5] 424,314
Miscellaneous		1,857,614		1,536,027
Total value, eliminating duplications		485,441		570,520

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Exclusive of limestone, value for which is included under "Miscellaneous."

Mineral production of South Carolina, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Barite ... short tons	(1)	(1)	(1)	(1)
Clay:				
Products		(1 2)		2 $777, 296
Raw ... short tons	91, 165	3 $662, 642	113, 791	3 861, 304
Copper ... pounds	400	32	240	20
Gold 4 ... troy ounces	642	22, 439	2, 274	79, 573
Mica, sheet ... pounds	(1)	(1)	(1)	(1)
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)
Ore (dry and siliceous) (gold and silver) ... short tons	3, 982	(6)	17, 467	(6)
Sand and gravel ... do	144, 953	90, 871	145, 934	107, 476
Silver ... troy ounces	487	315	1, 117	803
Stone ... short tons	431, 790	847, 860	444, 180	874, 180
Miscellaneous 7		361, 776		4, 128
Total value, eliminating duplications		1, 323, 293		1, 843, 476

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 Value not included in total value for State.
4 Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
5 No canvass.
6 Not valued as ore; value of recoverable metal content included under the metals.
7 Includes minerals indicated by "1" above.

Mineral production of South Dakota, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products		(1 2)		(1 2)
Raw ... short tons	(1 3)	(1 3)	8, 923	3 $40, 001
Coal ... do	42, 407	$76, 000	13, 243	21, 000
Feldspar (crude) ... long tons	9, 190	30, 892	22, 099	62, 498
Gems and precious stones		(4)		(4)
Gold 5 ... troy ounces	486, 119	16, 989, 858	567, 230	19, 853, 057
Gypsum ... short tons	(1)	(1)	(1)	(1)
Lead ... do			4	280
Lime ... do	(1)	(1)	(1)	(1)
Lithium minerals ... do	684	20, 480	1, 154	26, 834
Mica, scrap ... do	515	6, 665	(1)	(1)
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Natural gas ... M cubic feet	11, 000	4, 000	8, 000	3, 000
Ores (crude), etc.:				
Dry and siliceous (gold and silver) ... short tons	1, 520, 669	(6)	1, 487, 205	(6)
Lead ... do			30	(6)
Sand and gravel ... do	3, 863, 410	773, 559	4, 178, 035	794, 276
Sand-lime brick ... thousands			(1 2)	(1 2)
Silver ... troy ounces	99, 741	64, 479	151, 047	108, 565
Stone ... short tons	7 237, 510	7 497, 200	229, 420	585, 434
Tantalum ore ... pounds	425	168	7, 681	4, 521
Tin (metallic equivalent) ... do	445	(1)	711	400
Miscellaneous 8		734, 527		749, 689
Total value, eliminating duplications		19, 173, 033		22, 209, 554

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 Value not included in total value for State.
4 No canvass.
5 Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
6 Not valued as ore; value of recoverable metal content included under the metals.
7 Exclusive of basalt, value for which is included under "Miscellaneous."
8 Includes minerals indicated by "1" and "7" above.

Mineral production of Tennessee, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Aluminum pounds	(1 2)	(1 2)	(1 2)	(1 2)
Barite short tons	(1)	(1)	(1)	(1)
Cement barrels	2,305,578	$3,645,659	2,733,726	$4,203,078
Clay:				
Products		3 1,756,020		(1 3)
Raw short tons	47,665	2 215,511	60,694	2 299,926
Coal do	4,135,790	7,514,000	4,137,802	7,435,000
Coke do	76,591	2 399,003	81,767	2 352,693
Copper pounds	(1)	(1)	(1)	(1)
Ferro-alloys long tons	(1 2)	(1 2)	(1 2)	(1 2)
Fluorspar short tons			6	116
Fluorspar, optical			(4)	184
Gold 5 troy ounces	455	15,902	423	14,805
Iron:				
Ore—				
Sold to furnaces long tons	3,040	6,080	14,219	29,909
Sold for paint do	305	(1)		
Pig do	10,760	(1 2)	(1 2)	(1 2)
Sinter from copper sulphide ore do	(1)	(1)	(1)	(1)
Lead short tons	(1)	(1)	(1)	(1)
Lime do	122,818	650,625	146,622	814,834
Manganese ore long tons	1,088	(1)	1,893	(1)
Mineral waters gallons sold	(6)	(6)	(6)	(6)
Natural gas M cubic feet	12,000	4,000		
Ores (crude), etc.:				
Copper short tons	584,411	(7)	639,800	(7)
Lead-zinc do	20,000	(7)	14,000	(7)
Zinc do	808,215	(7)	736,440	(7)
Petroleum barrels	10,000	10,000	15,000	15,000
Phosphate rock long tons	423,879	1,797,766	548,548	2,305,986
Pyrites do	(1)	(1)	(1)	(1)
Sand and gravel short tons	1,713,539	1,115,891	1,611,642	1,076,724
Silica (quartz) do	(1)	(1)	(1)	(1)
Silver troy ounces	61,148	39,530	47,151	33,890
Slate		2,238		
Stone short tons	8 2,094,890	8 2,396,510	8 3,063,630	8 3,083,512
Sulphuric acid 9 do	(1 2)	(1 2)	(1 2)	(1 2)
Tripoli do	(1)	(1)		
Zinc do	(1)	(1)	(1)	(1)
Miscellaneous 10		10,762,323		15,883,960
Total value, eliminating duplications		23,525,650		25,743,471

1 Value included under "Miscellaneous."
2 Value not included in total value for State.
3 Figures obtained through cooperation with Bureau of the Census.
4 Weight not available.
5 Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
6 No canvass.
7 Not valued as ore; value of recoverable metal content included under the metals.
8 Exclusive of granite in 1934 and of unclassified stone in 1935, value for which is included under "Miscellaneous."
9 From copper smelting.
10 Includes minerals indicated by "1" and "8" above.

Mineral production of Texas, 1934–35

Product	1934 Quantity	1934 Value	1935 Quantity	1935 Value
Asphalt (native) short tons	(1)	(1)	74,594	$241,442
Briquets, fuel do	(1 2)	(1 2)	(1 2)	(1 2)
Cement barrels	3,418,781	$5,995,677	3,715,300	6,422,807
Clay:				
Products		[3] 1,246,341		[3] 1,736,529
Raw short tons	55,233	[3] 274,069	46,538	[3] 261,623
Coal do	759,289	1,145,000	757,529	654,000
Copper pounds	29,000	2,320	28,000	2,324
Fuller's earth short tons	32,763	325,397	40,925	391,641
Gems and precious stones		(4)		(4)
Gold [5] troy ounces	359	12,538	518	18,130
Gypsum short tons	138,326	1,403,454	179,783	1,812,605
Helium cubic feet	(1 6)	(1 6)	(1 6)	(1 6)
Lead short tons	360	26,603	522	41,720
Lime do	36,620	325,499	38,863	362,636
Mercury flasks (76 pounds)	(1)	(1)	(1)	(1)
Mineral waters gallons sold	(4)	(4)	(4)	(4)
Natural gas M cubic feet	602,976,000	95,056,000	642,366,000	101,046,000
Natural gasoline gallons	466,570,000	12,366,000	516,748,000	17,050,000
Ores (crude), etc.:				
Copper-lead short tons	1	(7)	56	(7)
Dry and siliceous (gold and silver) do	47,625	(7)	71,892	(7)
Lead do	54	(7)	274	(7)
Petroleum barrels	381,516,000	361,550,000	392,666,000	367,820,000
Potassium salts short tons	(1)	(1)		
Salt do	208,979	612,586	268,809	563,514
Sand and gravel do	4,572,594	2,621,360	4,895,362	2,839,513
Sand-lime brick thousands	(1 3)	(1 3)	(1 3)	(1 3)
Silver troy ounces	854,442	552,367	1,000,960	719,440
Sodium sulphate from natural sources short tons	(1)	(1)	11,875	133,424
Stone do	[8] 2,749,270	[8] 2,183,435	[8] 1,247,970	[8] 1,403,754
Sulphur long tons	1,302,663	23,447,934	1,354,101	24,373,818
Miscellaneous [9]		678,319		470,057
Total value, eliminating duplications		509,521,286		528,069,238

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
[6] For details of production in fiscal years see chapter on Helium.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Exclusive of basalt, value for which is included under "Miscellaneous"
[9] Includes minerals indicated by "1" and "8" above.

Mineral production of Utah, 1934–35

Product	1934 Quantity	1934 Value	1935 Quantity	1935 Value
Arsenious oxide short tons	7,829	$399,532	4,101	$161,016
Asphalt (native) do	30,399	603,374	33,288	699,355
Cement barrels	(1)	(1)	(1)	(1)
Clay:				
Products		[2] 250,209		(1 2)
Raw short tons	20,036	[3] 138,231	15,817	[3] 121,778
Coal do	2,406,183	4,746,000	2,946,918	6,091,000
Coke do	130,604	(1 3)	120,857	(1 3)
Copper pounds	86,024,925	6,881,994	129,515,217	10,749,763
Fluorspar short tons			180	(1)
Gems and precious stones		(4)		(4)
Gold [5] troy ounces	136,582	4,773,524	184,760	6,466,593
Gypsum short tons	(1)	(1)	(1)	(1)
Iron:				
Ore—				
Sold to furnaces long tons	161,009	(1)	161,010	(1)
Sold for paint do	100	(1)	(1)	(1)
Pig do	(1 3)	(1 3)	(1 3)	(1 3)
Lead short tons	58,077	4,297,696	63,510	5,080,767
Lime do	9,611	97,363	15,957	152,586
Manganiferous ore long tons			190	(1)
Natural gas M cubic feet	182,000	43,000	98,000	22,000
Ores (crude), etc.:				
Copper short tons	4,092,303	(6)	6,530,569	(6)
Copper-lead do	127	(6)	11	(6)
Dry and siliceous (gold and silver) do	478,119	(6)	635,171	(6)
Lead do	67,634	(6)	78,332	(6)
Lead-zinc do	438,552	(6)	527,513	(6)
Petroleum barrels	4,000	4,000	3,000	4,000
Potassium salts short tons	(1)	(1)	(1)	(1)
Salt do	(1)	(1)	57,625	163,639
Sand and gravel do	1,837,314	1,494,700	1,811,105	1,030,687
Silver troy ounces	7,111,417	4,597,280	9,206,329	6,617,049
Stone short tons	[7] 389,820	[7] 236,714	215,230	169,865
Sulphur long tons			(1)	(1)
Sulphuric acid [8] short tons	(1 3)	(1 3)	(1 3)	(1 3)
Uranium ores do	76	2,828	(1)	(1)
Zinc do	28,198	2,425,040	31,107	2,737,399
Miscellaneous [9]		4,062,734		4,005,802
Total value, eliminating duplications		32,527,119		41,881,265

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 Value not included in total value for State.
4 No canvass.
5 Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
6 Not valued as ore; value of recoverable metal content included under the metals.
7 Exclusive of marble, value for which is included under "Miscellaneous."
8 From copper smelting.
9 Includes minerals indicated by "1" and "7" above.

Mineral production of Vermont, 1934–35

Product	1934 Quantity	1934 Value	1935 Quantity	1935 Value
Asbestos short tons	(1)	(1)	8,535	$244,552
Clay:				
Products		(1 2)		(1 2)
Raw short tons	(1 3)	(1 3)		
Lime do	31,218	$242,551	37,143	274,792
Mineral waters gallons sold	(4)	(4)	(4)	(4)
Sand and gravel short tons	395,577	196,469	284,947	137,216
Scythestones do	(1)	(1)	(1)	(1)
Slate		579,582		829,709
Stone short tons	238,140	3,321,801	[5] 158,590	[5] 3,189,170
Talc do	34,243	313,346	42,739	381,643
Miscellaneous [6]		200,325		40,213
Total value, eliminating duplications		4,852,949		5,097,295

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 Value not included in total value for State.
4 No canvass.
5 Exclusive of sandstone, value for which is included under "Miscellaneous."
6 Includes minerals indicated by "1" and "5" above.

Mineral production of Virginia, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Barite......short tons..	(1)	(1)	9,450	$46,411
Cement......barrels..	(1)	(1)	(1)	(1)
Clay:				
Products......	----------	[2] $1,255,579	----------	(1 2)
Raw......short tons..	5,099	[3] 33,892	8,185	[3] 59,160
Coal......do....	9,376,681	16,375,000	9,667,018	17,128,000
Coke......do....	77,960	[3] 324,063	137,587	[3] 547,295
Copper......pounds..	400	32	700	58
Feldspar (crude)......long tons..	12,140	64,529	14,810	81,474
Ferro-alloys......do....	(1 3)	(1 3)	(1 3)	(1 3)
Gold [4]......troy ounces..	667	23,315	653	22,840
Gypsum......short tons..	(1)	(1)	(1)	(1)
Iron:				
Ore......long tons..	297	594	942	3,015
Pig......do....	3,843	(1 3)	(1 3)	(1 3)
Lead......short tons..	(1)	(1)	(1)	(1)
Lime......do....	94,041	610,649	133,696	850,444
Manganese ore......long tons..	1,597	25,821	2,452	35,995
Manganiferous ore......do....	40	300	645	4,110
Marl, calcareous......short tons..	3,208	4,353	(1)	(1)
Mica:				
Scrap......do....	(1)	(1)	(1)	(1)
Sheet......pounds..	(1)	(1)	(1)	(1)
Millstones......	----------	(1)	----------	(1)
Mineral waters......gallons sold..	(5)	(5)	(5)	(5)
Ores (crude), etc.:				
Dry and siliceous (gold and silver)......short tons..	12,000	(6)	3,921	(6)
Lead-zinc......do....	251,144	(6)	314,800	(6)
Phosphate rock......long tons..	(1)	(1)	(1)	(1)
Pyrites......do....	(1)	(1)	(1)	(1)
Salt......short tons..	(1)	(1)	(1)	(1)
Sand and gravel......do....	1,731,086	1,359,081	1,866,686	1,438,282
Sand and sandstone (finely ground)......do....	----------	----------	(1)	(1)
Silica (quartz)......do....	(1)	(1)	----------	----------
Silver......troy ounces..	103	67	55	40
Slate......	----------	[7] 113,035	----------	[7] 135,637
Stone [8]......short tons..	[9] 2,883,140	[9] 3,103,403	[9] 2,901,630	[9] 3,274,789
Talc and ground soapstone [8]......do....	(1)	(1)	(1)	(1)
Titanium minerals:				
Ilmenite......do....	(1)	(1)	(1)	(1)
Rutile......do....	(1)	(1)	(1)	(1)
Zinc......do....	(1)	(1)	(1)	(1)
Miscellaneous [10]......	----------	5,938,542	----------	9,960,819
Total value, eliminating duplications......	----------	28,309,377	----------	30,923,115

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of granules, etc., value for which is included under "Miscellaneous."
[8] Soapstone used as dimension stone included in figures for stone.
[9] Exclusive of marble, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "1", "7", and "9" above.

Mineral production of Washington, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Asbestos short tons	[1]	[1]	----------	----------
Briquets, fuel do	[1,2]	[1,2]	[1,2]	[1,2]
Cement barrels	[1]	[1]	[1]	[1]
Clay:				
Products	----------	[1,3]	----------	[3] $770,833
Raw short tons	17,701	[3] $14,360	8,557	[3] 10,191
Coal do	1,382,991	4,002,000	1,559,206	4,686,000
Coke do	28,893	[3] 178,092	31,219	[3] 186,385
Copper pounds	13,900	1,112	86,699	7,196
Diatomite short tons	456	6,003	[1]	[1]
Gold [4] troy ounces	8,302	290,149	9,740	340,886
Iron ore long tons	1,920	[1]	5,062	[1]
Lead short tons	291	21,508	103	8,246
Lime do	22,764	247,151	34,471	247,399
Magnesite do	[1]	[1]	[1]	[1]
Magnesium sulphate (natural) pounds	[1]	[1]	[1]	[1]
Mercury flasks (76 pounds)	330	24,375	106	7,631
Mineral waters gallons sold	[5]	[5]	[5]	[5]
Natural gas M cubic feet	104,000	75,000	138,000	95,000
Ores (crude), etc.:				
Copper short tons	----------	----------	752	[6]
Dry and siliceous (gold and silver) do	19,420	[6]	31,145	[6]
Lead do	160	[6]	287	[6]
Lead-zinc do	28,322	[6]	3	[6]
Peat do	----------	----------	1,443	11,849
Platinum troy ounces	1	35	----------	----------
Pulpstones short tons	[1]	[1]	[1]	[1]
Sand and gravel do	3,311,009	1,288,918	3,299,572	1,366,163
Silver troy ounces	44,120	28,522	52,338	37,618
Sodium sulphate from natural sources short tons	[1]	[1]	5	1,200
Stone do	3,059,130	2,796,231	3,068,360	2,714,282
Talc do	500	1,250	633	2,550
Tungsten ore (60 percent concentrates) do	164	[1]	192	[1]
Zinc do	1,926	165,654	1	95
Miscellaneous [7]	----------	4,033,356	----------	3,336,893
Total value, eliminating duplications	----------	12,944,751	----------	13,688,083

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Includes minerals indicated by "1" above.

Mineral production of West Virginia, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Briquets, fuel ... short tons	94,745	[1] $325,432	[1 2]	[1 2]
Bromine ... pounds	406,765	63,690	499,100	$77,873
Calcium chloride ... short tons	4,701	38,529	6,560	42,193
Cement ... barrels	[2]	[2]	[2]	[2]
Clay:				
Products		[3] 13,065,783		[3] 13,798,693
Raw ... short tons	28,658	[1] 51,250	38,670	[1] 70,654
Coal ... do	98,134,393	167,104,000	99,179,061	169,164,000
Coke ... do	1,515,432	[1] 4,201,663	1,758,795	[1] 4,894,030
Ferro-alloys ... long tons	[1 2]	[1 2]	[1 2]	[1 2]
Grindstones and pulpstones ... short tons	4,260	208,174	4,397	187,062
Iron, pig ... long tons	439,261	[1 2]	672,104	[1 2]
Lime ... short tons	143,071	904,438	211,904	1,404,087
Marl, calcareous ... do	[2]	[2]	[2]	[2]
Mineral waters ... gallons sold	[4]	[4]	[4]	[4]
Natural gas ... M cubic feet	109,161,000	44,263,000	115,772,000	45,820,000
Natural gasoline ... gallons	41,854,000	1,706,000	42,433,000	2,070,000
Petroleum ... barrels	4,095,000	8,600,000	3,902,000	7,220,000
Salt ... short tons	66,766	384,342	65,968	433,855
Sand and gravel ... do	1,836,495	1,886,405	2,065,844	1,897,841
Sand and sandstone (finely ground) ... do	[2]	[2]	[2]	[2]
Stone ... do	2,106,130	1,912,766	1,897,670	1,745,035
Sulphuric acid [5] ... do	[1 2]	[1 2]	[1 2]	[1 2]
Miscellaneous [6]		10,322,395		17,300,655
Total value, eliminating duplications		241,473,621		245,402,124

[1] Value not included in total value for State.
[2] Value included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] From zinc smelting.
[6] Includes minerals indicated by "2" above.

Mineral production of Wisconsin, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Briquets, fuel ... short tons	329,942	[1] $2,174,168	410,715	[1] $2,986,847
Cement ... barrels	[2]	[2]	[2]	[2]
Clay:				
Products		[3] 923,587		[3] 2,286,144
Raw ... short tons			[1 2]	[1 2]
Coke ... do	[1 2]	[1 2]	[1 2]	[1 2]
Iron ore—				
Sold to furnaces ... long tons	595,891	1,565,958	722,224	1,949,568
Sold for paint ... do	263	[2]	272	[2]
Lead ... short tons	234	17,316	286	22,880
Lime ... do	33,856	296,685	39,324	347,656
Manganiferous ore ... long tons	343	1,029	6,617	[2]
Marl, calcareous ... short tons	1,505	1,906	68,746	53,589
Mineral waters ... gallons sold	[4]	[4]	[4]	[4]
Ores (crude), etc.:				
Lead-zinc ... short tons	287,800	[5]	236,000	[5]
Zinc ... do	20,800	[5]		
Pyrites ... long tons	[2]	[2]	[2]	[2]
Sand and gravel ... short tons	4,773,302	1,836,722	4,776,673	2,066,516
Sand and sandstone (finely ground) ... do	[2]	[2]	[2]	[2]
Sand-lime brick ... thousands			[2 3]	[2 3]
Stone ... short tons	2,679,860	3,114,882	[6] 2,495,400	[6] 3,117,196
Sulphuric acid [7] ... do	[1 2]	[1 2]	[1 2]	[1 2]
Zinc ... do	9,807	843,402	8,923	785,224
Miscellaneous [8]		4,743,661		5,143,565
Total value, eliminating duplications		9,752,431		11,815,933

[1] Value not included in total value for State.
[2] Value included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of basalt, value for which is included under "Miscellaneous."
[7] From zinc-roasting operation.
[8] Includes minerals indicated by "2" and "6" above.

Mineral production of Wyoming, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Briquets, fuel ... short tons			(1 2)	(1 2)
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products		(1 3)		(1 3)
Raw ... short tons	27,162	[2] $246,562	34,426	[2] $350,945
Coal ... do	4,367,961	9,591,000	5,177,142	11,127,000
Copper ... pounds	3,500	280	1,000	83
Gold [4] ... troy ounces	4,871	170,254	3,715	130,025
Gypsum ... short tons	(1)	(1)	(1)	(1)
Iron ore ... long tons	116,562	(1)	339,134	(1)
Lead ... short tons	1	74	3	200
Micaceous minerals (vermiculite) ... do			200	2,525
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)
Natural gas ... M cubic feet	23,148,000	3,446,000	26,643,000	4,125,000
Natural gasoline ... gallons	34,799,000	1,598,000	32,246,000	1,511,000
Ores (crude), etc.:				
Copper ... short tons	3	(6)		
Copper-lead ... do			18	(6)
Dry and siliceous (gold and silver) ... do	8,164	(6)	4,172	(6)
Lead ... do	6	(6)		
Petroleum ... barrels	12,556,000	10,550,000	13,755,000	11,730,000
Potassium salts ... short tons	(1)	(1)	(1)	(1)
Sand and gravel ... do	1,589,156	822,931	1,619,063	476,459
Silver ... troy ounces	710	459	1,152	828
Sodium sulphate from natural sources ... short tons	(1)	(1)	1,927	13,077
Stone ... do	655,030	658,375	265,140	281,718
Miscellaneous [7]		802,921		1,307,493
Total value, eliminating duplications		27,640,294		30,669,658

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Includes minerals indicated by "1" above.

Mineral production of West Virginia, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Briquets, fuel .... short tons	94,745	[1] $325,432	(1 2)	(1 2)
Bromine .... pounds	406,765	63,690	499,100	$77,873
Calcium chloride .... short tons	4,701	38,529	6,560	42,193
Cement .... barrels	(2)	(2)	(2)	(2)
Clay:				
Products		[3] 13,065,783		[3] 13,798,693
Raw .... short tons	28,658	[1] 51,250	38,670	[1] 70,654
Coal .... do	98,134,393	167,104,000	99,179,061	169,164,000
Coke .... do	1,515,432	[1] 4,201,663	1,758,795	[1] 4,894,030
Ferro-alloys .... long tons	(1 2)	(1 2)	(1 2)	(1 2)
Grindstones and pulpstones .... short tons	4,260	208,174	4,397	187,062
Iron, pig .... long tons	439,261	(1 2)	672,104	(1 2)
Lime .... short tons	143,071	904,438	211,904	1,404,087
Marl, calcareous .... do	(2)	(2)	(2)	(2)
Mineral waters .... gallons sold	(4)	(4)	(4)	(4)
Natural gas .... M cubic feet	109,161,000	44,263,000	115,772,000	45,820,000
Natural gasoline .... gallons	41,854,000	1,706,000	42,433,000	2,070,000
Petroleum .... barrels	4,095,000	8,600,000	3,902,000	7,220,000
Salt .... short tons	66,766	384,342	65,968	433,855
Sand and gravel .... do	1,836,495	1,886,405	2,065,844	1,897,841
Sand and sandstone (finely ground) .... do	(2)	(2)	(2)	(2)
Stone .... do	2,106,130	1,912,766	1,897,670	1,745,035
Sulphuric acid [5] .... do	(1 2)	(1 2)	(1 2)	(1 2)
Miscellaneous [6]		10,322,395		17,300,655
Total value, eliminating duplications		241,473,621		245,402,124

[1] Value not included in total value for State.
[2] Value included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] From zinc smelting.
[6] Includes minerals indicated by "2" above.

Mineral production of Wisconsin, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Briquets, fuel .... short tons	329,942	[1] $2,174,168	410,715	[1] $2,986,847
Cement .... barrels	(2)	(2)	(2)	(2)
Clay:				
Products		[3] 923,587		[3] 2,286,144
Raw .... short tons			(1 2)	(1 2)
Coke .... do	(1 2)	(1 2)	(1 2)	(1 2)
Iron ore—				
Sold to furnaces .... long tons	595,891	1,565,958	722,224	1,949,568
Sold for paint .... do	263	(2)	272	(2)
Lead .... short tons	234	17,316	286	22,880
Lime .... do	33,856	296,685	39,324	347,656
Manganiferous ore .... long tons	343	1,029	6,617	(2)
Marl, calcareous .... short tons	1,505	1,906	68,746	53,589
Mineral waters .... gallons sold	(4)	(4)	(4)	(4)
Ores (crude), etc.:				
Lead-zinc .... short tons	287,800	(5)	236,000	(5)
Zinc .... do	20,800	(5)		
Pyrites .... long tons	(2)	(2)	(2)	(2)
Sand and gravel .... short tons	4,773,302	1,836,722	4,776,673	2,066,516
Sand and sandstone (finely ground) .... do	(2)	(2)	(2)	(2)
Sand-lime brick .... thousands			(2 3)	(2 3)
Stone .... short tons	2,679,860	3,114,882	[6] 2,495,400	[6] 3,117,196
Sulphuric acid [7] .... do	(1 2)	(1 2)	(1 2)	(1 2)
Zinc .... do	9,807	843,402	8,923	785,224
Miscellaneous [8]		4,743,661		5,143,565
Total value, eliminating duplications		9,752,431		11,815,933

[1] Value not included in total value for State.
[2] Value included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of basalt, value for which is included under "Miscellaneous."
[7] From zinc-roasting operation.
[8] Includes minerals indicated by "2" and "6" above.

Mineral production of Wyoming, 1934–35

Product	1934		1935	
	Quantity	Value	Quantity	Value
Briquets, fuel ..... short tons			(1 2)	(1 2)
Cement [3] ..... barrels	(1)	(1)	(1)	(1)
Clay:				
Products		(1 3)		(1 3)
Raw ..... short tons	27,162	[2] $246,562	34,426	[2] $350,945
Coal ..... do	4,367,961	9,591,000	5,177,142	11,127,000
Copper ..... pounds	3,500	280	1,000	83
Gold [4] ..... troy ounces	4,871	170,254	3,715	130,025
Gypsum ..... short tons	(1)	(1)	(1)	(1)
Iron ore ..... long tons	116,562	(1)	339,134	(1)
Lead ..... short tons	1	74	3	200
Micaceous minerals (vermiculite) ..... do			200	2,525
Mineral waters ..... gallons sold	(5)	(5)	(5)	(5)
Natural gas ..... M cubic feet	23,148,000	3,446,000	26,643,000	4,125,000
Natural gasoline ..... gallons	34,799,000	1,598,000	32,246,000	1,511,000
Ores (crude), etc.:				
Copper ..... short tons	3	(6)		
Copper-lead ..... do			18	(6)
Dry and siliceous (gold and silver) ..... do	8,164	(6)	4,172	(6)
Lead ..... do	6	(6)		
Petroleum ..... barrels	12,556,000	10,550,000	13,755,000	11,730,000
Potassium salts ..... short tons	(1)	(1)	(1)	(1)
Sand and gravel ..... do	1,589,156	822,931	1,619,063	476,459
Silver ..... troy ounces	710	459	1,152	828
Sodium sulphate from natural sources ..... short tons	(1)	(1)	1,927	13,077
Stone ..... do	655,030	658,375	265,140	281,718
Miscellaneous [7]		802,921		1,307,493
Total value, eliminating duplications		27,640,294		30,669,658

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Gold valued per ounce, as follows: 1934, $34.95; 1935, $35.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Includes minerals indicated by "1" above.

WORLD PRODUCTION OF MINERALS AND ECONOMIC ASPECTS OF INTERNATIONAL MINERAL POLICIES

By J. S. McGrath

SUMMARY OUTLINE

Continued increases in world production of most minerals during 1936 are less significant than the evidence of determined effort by many countries to achieve national self-sufficiency through the adoption or more vigorous application of measures restricting trade. The problem of insuring adequate supplies of mineral raw materials and its relationship to the achieving of economic self-sufficiency—the apparent goal of several major industrial countries—has not been solved as yet by exchange-control systems, barter transactions, import quotas, export restrictions, forced substitutions, and similar practices.

World production.—In 1936 the world production of industrial mineral raw materials approximated the peak output of 1928 and 1929; the production of a few minerals, notably crude petroleum, manganese ore, and aluminum, even surpassed that in the two peak years preceding the world depression. The acceleration of world production and distribution of industrial minerals from the low point of the world depression has been more noticeable in the 4 years beginning with 1933 than during the period immediately preceding the peak of 1929. Imports of key minerals by major consumer nations may be cited as indicative of continued annual increases in world production during 1936. In 1936 imports of virtually all minerals maintained at least the level of 1935 and, in a few instances, increased. For example, Germany's imports of bauxite increased 78 percent and of iron ore 33 percent; imports of iron ore into the United Kingdom increased 29 percent, of pig iron 185 percent, and of manganese ore 6 percent; and imports of iron ore into the United States increased 50 percent, of manganese ore 121 percent, and of pig tin 23 percent.

World consumption.—A major portion of the world output of mineral raw materials is consumed by relatively few countries, as the accompanying tables indicate.

In calculating apparent consumption by Japan, the production of Korea (Chosen), Formosa (Taiwan), and Sakhalin has been included; the consumption estimates for other countries do not include the output by colonial possessions.

Estimated annual average world production of principal mineral commodities, 1933–35, and percentage produced and consumed by 8 countries [1]

Commodity	World production (long tons)	Percent produced by 8 countries [1]	Percent consumed by 8 countries [1]
Aluminum	187,300	75	92
Bauxite	1,346,600	67	94
Primary copper	1,273,300	52	85
Pig iron	54,607,000	97	99
Iron ore	116,000,000	82	93
Manganese ore	2,930,000	61	91
Tin in pigs and bars	117,000	27	86
Tin ore	115,600	3	40
Crude petroleum	209,666,600	72	75
Coal	1,233,333,300	85	80

[1] Belgium, France, Germany, Italy, Japan, U. S. S. R. (Russia), United Kingdom, and United States.

Apparent annual average consumption of principal mineral commodities, 1933–35, and approximate percentage of consumption imported

Commodity	Belgium		France		Germany		Italy	
	Long tons	Percent imported	Long tons	Percent imported	Long tons	Percent imported	Long tons	Percent imported
Aluminum	930	100	14,660	2	48,730	18	8,100	(1)
Bauxite	1,060	100	236,930	(1)	356,830	98	129,930	(1)
Primary copper	79,000	100	109,530	100	191,400	84	69,800	100
Pig iron	4,913,300	4	7,021,830	1	6,871,130	1	631,030	1
Iron ore	13,209,500	76	18,465,600	3	12,791,530	69	798,700	34
Manganese ore	197,630	100	474,060	100	244,800	100	86,030	92
Tin pigs and bars	1,430	100	9,100	100	12,830	100	4,100	100
Tin ore	5,100	100	600	100	730	100	(2)	(1)
Crude petroleum	143,660	100	4,234,000	98	674,530	52	183,860	89
Coal	26,383,100	17	70,063,000	24	242,810,560	2	11,813,860	93

Commodity	Japan		U. S. S. R. (Russia)		United Kingdom		United States	
	Long tons	Percent imported	Long tons	Percent imported	Long tons	Percent imported	Long tons	Percent imported
Aluminum	7,700	80	19,830	27	24,700	59	47,030	17
Bauxite	(2)	(1)	79,600	(1)	156,730	100	302,130	57
Primary copper	109,860	38	68,030	23	218,630	99	232,800	3
Pig iron	2,437,160	30	9,716,660	(1)	5,408,660	2	16,848,260	1
Iron ore	2,963,800	79	20,408,060	(1)	13,517,300	29	25,300,260	5
Manganese ore	128,930	63	1,036,460	(1)	182,960	100	317,900	92
Tin pigs and bars	4,960	80	5,700	100	7,360	83	54,800	100
Tin ore	1,760	100	(2)	(1)	38,530	95	85	80
Crude petroleum	2,845,900	92	22,908,000	(1)	1,927,760	94	125,292,730	4
Coal	38,694,130	1	87,778,330	(3)	161,075,130	(3)	352,476,030	(3)

[1] No imports reported.
[2] No domestic consumption reported.
[3] Less than 0.5 percent.

Changes in world distribution.—Although world production and international trade in minerals have advanced rapidly since 1934 there have been more significant changes in regional distribution of world

output. Industrialization of many countries in southeastern and eastern Europe and South America, heretofore unimportant consumers of mineral raw materials, has progressed noticeably in recent years and has resulted in the adoption of certain protectionist policies to safeguard infant industries.

During 1936 the world was confronted with two conflicting methods of conducting international trade. Tariffs, which leave the promotion and development of foreign trade to the initiative of individuals, are recognized as one form of trade regulation or control. The reciprocal-trade-agreement program of the United States is an example; this program is based upon the Trade Agreements Act of June 12, 1934, and agreements with 14 countries resulted, of which 10 became effective in 1936, 3 in 1935, and 1 in 1934. The purpose of the trade-agreement program has been the expansion of foreign markets for surplus output through tariff adjustments. However, such agreements have been made largely because of the trade barriers and discriminatory practices of many foreign countries.

Contrasted with this method of promoting reciprocal trade are other forms of trade control and regulation now effective in many countries, the administration of which is also centralized in the national government. Such measures may be import quota restrictions, which tend to diminish or abolish trade with certain countries; import and export license requirements; exchange control systems, which are responsible for the adoption of "clearing" agreements limiting trade to the amount of foreign exchange available; and compensation or barter agreements. Exchange controls and regulations, effectively administered, enable the governments concerned to designate the countries with which their nationals may trade.

NATIONAL SELF-SUFFICIENCY OBJECTIVE OF EUROPEAN NATIONS

National policies in virtually all European countries—adopted largely since 1934 and applied most vigorously in 1936—have resulted in a change in the composition of foreign trade of these countries. Many such policies have been adopted to decrease the dependence of the major consumer nations on foreign sources for essential mineral raw materials. In certain instances, imports of raw materials have been reduced. However, the most noticeable effect of these policies has been diversion of the flow from major sources of supply, provided by nature with exportable surpluses, to secondary sources of supply with which the importing country has been able to negotiate trade-bargaining measures, the primary purpose of which is to increase exports of manufactured products.

A large percentage of world consumption of minerals is concentrated in central and western Europe, where dependence on imports for many such raw materials has resulted in drastic control measures. There was evidence in 1936 of more vigorous application of government decrees intended to reduce dependence on imports to a minimum yet assure adequate supplies to domestic industries through stimulated domestic production. In April 1936 the exportation of iron and steel products from Belgium was subjected to export licenses. In August 1936 the exportation of iron ore from France was prohibited, although exceptions to the prohibition were provided for under conditions established by the Minister of Finance. France likewise extended the prohibition against exportation, except under license, of scrap

153336—37——8

lead, copper, tin, zinc, and nickel to include ingots derived from the melting of such scrap. Under revised regulations for the control of foreign trade during the third quarter of 1936, the list of products which could be imported into Italy only under a ministerial license without quota limitations included iron and steel structural forms, aluminum, antimony, nickel, and platinum. In April 1936 Italy likewise revised its regulations governing the importation of goods acquired through compensation or barter agreements which placed all commodities in seven groups, each group containing both import and export products. In general, export products can be compensated only against the import products listed in the same group, although provision is made for exceptions.

Germany.—From within its own confines Germany can provide supplies of coal and potash adequate to meet domestic requirements. However, from 1933 to 1935, 69 percent of its apparent consumption of iron ore, 100 percent of its consumption of manganese, and 52 percent of its apparent consumption of petroleum were imported. It also depends on imports for pig-tin requirements. Germany is the world's principal producer and consumer of aluminum metal, despite the fact that during the past 4 years more than 98 percent of the bauxite consumed was imported. Germany's industries depend on foreign sources of supply for all the minerals they require except coal and potash. The position of Germany as a major industrial nation, without adequate domestic reserves or colonial sources of essential raw materials, is unique, and because of its relative importance as a consumer of such products policies adopted during and prior to 1936, but more vigorously applied in 1936, deserve more than casual attention. Such national policies have had a definite influence on the trade relationships that now exist among other European countries, as well as on those between Germany and foreign countries.

Late in 1934 the German "Four-Year Plan" or "New Plan" was inaugurated. This plan is based on the premise that Germany should import no more than can be paid for. Germany's foreign trade with individual countries has varied greatly since then. Export trade with other European countries in the past enabled Germany to maintain purchases of raw materials in overseas markets. By 1934 the decrease in exports of finished products to other European countries resulted in adoption by Germany of purchase prohibitions and restrictions of foreign-exchange quotas. Ultimately the country became an importer of semifinished and finished products from western European countries, acquired through "clearing accounts", while imports of basic raw materials from abroad decreased materially owing to lack of exchange with countries capable of supplying essential raw materials. Since 1934 "clearing agreements" have been negotiated with virtually all southeastern European countries and several South American countries, as a result of which importation of raw materials from these areas has increased and imports from other European countries as well as other overseas sources of supply have decreased decidedly. Immediately prior to and during 1936 the trade relations between Germany and North American countries changed as a result of national policies adopted primarily to stimulate domestic production of essential raw materials, to reduce imports of such materials to a minimum, and to increase exports of finished products manufactured therefrom.

"Clearing account" transactions between Germany and other European countries have had a decided influence on the sources from

which essential raw materials have been obtained and the markets in which manufactured products have been distributed. By the end of 1936 Germany had "clearing agreements" with all European countries except Albania and Iceland. During 1936 Germany's foreign trade fluctuated considerably with countries with which a "clearing agreement" was in force. The accumulation of German exchange in many countries, attributed largely to the purchase of raw materials, resulted in restrictions by certain countries, especially the U. S. S. R. (Russia) and Yugoslavia, on exports of products to Germany to accelerate reduction of unfavorable trade balances. Germany's imports of manganese ore, which amounted to 394,256 metric tons in 1935, dropped more than 160,000 tons in 1936. This decline in tonnage, however, is less significant than the shift in countries of origin. In 1935 the U. S. S. R. (Russia) furnished 228,349 tons or 58 percent of Germany's imports compared with only 14 percent in 1936. In 1936, 47 percent of the manganese ore imported originated in the Union of South Africa and 22 percent in British India. The decline in German imports of Russian manganese ore is attributed to difficulties in trade relations that developed in 1936. These difficulties have also affected the trade in phosphate rock and petroleum. Negotiations between Germany and the U. S. S. R. (Russia) for the purchase of Russian manganese ore against certificates for German goods, or on the basis of compensation or barter trade, are reported to have been under consideration by the Soviet Union toward the end of 1936.

Compensation or barter trade between Germany and foreign countries in 1936 was largely controlled or regulated by the National Government. Prior to 1936 the Government, owing to the character of imports obtained on the basis of private barter, was confronted with the problem of ever-increasing imports of goods that were not considered absolutely indispensable to German industry. Likewise, it was found that in exchange for such goods imported, manufacturers and exporters were negotiating private-barter transactions involving German goods which could be sold abroad against available foreign exchange. This situation prompted the Foreign Exchange Board to issue new regulations, effective December 27, 1935, which definitely limited the character of goods that might be imported and exported on a private-barter basis. These regulations applied to German foreign trade generally, but they restricted trade more noticeably with North America, particularly the United States. They provide that only one-third of the value of German merchandise exported may be charged to private-barter accounts or agreements. The remaining two-thirds must be paid for by foreign buyers in reichsmarks or available foreign exchange. Special provisions in the decree cover goods that are classified as of vital importance to Germany.

International trade has been affected materially by exchange-control systems adopted in most central European countries, several South American countries, and certain southeastern European countries. The clearing agreements and compensation agreements in effect at present represent attempts to maintain an equilibrium in trade balances of countries that have adopted exchange-control systems.

The German policy of purchasing raw materials from countries that increase their imports of German manufactures has diverted the flow of mineral raw materials from sources that heretofore supplied a major portion of Germany's requirements to secondary sources of

supply that are of minor importance as industrial nations and depend on imports of semimanufactured and finished products. In 1935[1] there were 29 secondary sources of supply or entrepots from which Germany purchased certain ores compared with 15 such markets in 1934; there were 6 primary markets in 1935 from which purchases of ores were negotiated by barter or clearing agreements compared with 4 in 1934. There were 57 primary markets from which Germany formerly purchased a greater portion of its essential imports of metals in 1935 at relatively low prices compared with 90 such markets in 1934. In two primary markets purchases were made by barter compared with one such market in 1934. There were 43 secondary markets or entrepots in 1935 compared with 49 such markets in 1934. Of special significance are the increasing number of secondary sources or reexport markets from which Germany is apparently purchasing considerable essential raw materials and the consequent decrease in the number of primary sources of supply. During the 3-year period 1933 to 1935, inclusive, 84 percent of the primary copper consumed in Germany was imported, and 15 percent of the imports originated in the United States. During the first 11 months of 1936, 117,600 metric tons of primary copper were imported by Germany, but only about 5 percent is credited to the United States. Of significance is the increase in imports of copper from Yugoslavia, with which country Germany has a clearing agreement. According to the German press a shift in the purchase of raw materials during 1936 reflects the operation of the "Four-Year Plan" or "New Plan", which provides for the purchase of raw materials from countries that exhibit "increased willingness" to buy German manufactured products.

Germany's imports of bauxite also illustrâte the effect of its trade policy. In 1929, France, the world's principal producer and exporter of bauxite, supplied Germany with about 40 percent of the tonnage imported, while Yugoslavia furnished only about 17 percent. In 1935 France contributed 15 percent, Yugoslavia 30 percent, Hungary 43 percent, and Italy 11 percent of Germany's total imports of bauxite. During the first 11 months of 1936 total imports of bauxite into Germany were 867,071 metric tons, an increase of approximately 78 percent over 1935. Of this total, France accounted for only 10 percent, Yugoslavia 21 percent, Hungary 34 percent, Italy 16 percent, and Netherland India 13 percent.

The German "Four-Year Plan", the objective of which is national economic self-sufficiency, has confronted domestic consumers of mineral raw materials with problems that require the active and constant assistance of the National Government for their solution. Copper and lead are produced in Germany but in quantities too small to meet requirements. Germany's reserves of bauxite are entirely inadequate; and its aluminum industry, which ranks first in the world, depends entirely on imports of the raw material. Although attention has been focused on technical processes for the recovery of aluminum from domestic clays, nevertheless the ability of Germany to use metallic aluminum as a substitute for other nonferrous metals is at present predicated on imports of commercial grades of bauxite. Substitutions have already been effected in the use of metals in Germany, and additional shifts are proposed under the "Four-Year Plan" which may decrease Germany's dependence on imports of

[1] Neue Wirtschaftsdienst, Folge 20, Sept. 6, 1935, p. 1217.

certain ores and metals. The cost factor of raw materials obtained from low-grade domestic deposits and through substitution is recognized as of secondary importance compared with the principal objective, national self-sufficiency. To further the latter a decree of the German Government, effective December 1, 1936, imposes an obligation upon owners of mining property to carry on prospecting and test-drilling operations when ordered to do so by the proper authorities. This law is regarded as a measure of the "Four-Year Plan" intended to force development of domestic mineral and metal production to the maximum point attainable, and it was enacted to overcome legal difficulties where there is an urgent national interest in development of mining properties whose owners remain inactive.

Germany has established boards of control which regulate the use and consumption of nonferrous metals, iron and steel products, and coal. These boards not only regulate and, in many instances, restrict the tonnage of ores and metals consumed by various industries, but also decide what ores and metals may be used or consumed. It is reported that in working out their regulations the boards consult specialists in the various lines of industry and that no specific prohibition is decreed without determining that a serviceable substitute material is available.

Southeastern Europe.—The countries of southeastern Europe, considered collectively, have a diversified and comparatively adequate supply of mineral raw materials with which to develop industrially. Lack of adequate private capital for expansion of industry is one of the most important problems in southeastern European countries; consequently the various governments have taken an active part in the development of domestic mineral reserves. Except for Rumanian petroleum, mineral raw materials of this area have been only partly developed. Yugoslavia, Bulgaria, and Rumania have the most important coal deposits in this region, while Greece depends on imports for her requirements. Rumania, which ranks fourth as a world producer of petroleum, exports about two-thirds of its annual output to countries other than those of southeastern Europe. Yugoslavia, now the most important producer of iron ore, is followed by Greece, and most of the production of these countries is exported. Hungary, although a producer of iron ore, depends on imports for its domestic requirements. Yugoslavia is now the second largest producer of copper ore in Europe. Yugoslavia and Greece are the principal European producers of chrome ore, except for the U. S. S. R. (Russia), while Bulgaria and Rumania are minor producers. Lead ore is produced in Yugoslavia, Rumania, Greece, and Czechoslovakia. Yugoslavia and Hungary follow France, the United States, and Italy as world producers of bauxite and have supplied the increased German requirements. Rumania also produces bauxite.

Despite the output of ores in this region, metal production in southeastern Europe is as yet little developed. Hungary, Rumania, and Yugoslavia are the most important producers of iron and steel products, and copper and lead are produced by Yugoslavia. Copper is the only metal exported from this region.

The extent of industrialization in southeastern Europe may be gleaned from certain Government decrees enacted during 1936. The Yugoslav Government restricted imports of various products by requiring preliminary authorizations from the National Bank. By a decision of the Ministry of Finance the restriction was made effective for all imports from France and Germany as of April 21, 1936. It

was reported that the purpose of this measure was to promote trade with countries that are heavy purchasers of Yugoslav products and to force countries that limit their imports by quota restrictions to increase the quotas on Yugoslav products. In March 1936 a Rumanian prohibition was placed on the exportation of copper in the form of ingots, plates, bars, and scrap. In July 1936 imports of copper plates and sheets into Czechoslovakia were made subject to permit requirements, and in June 1936 imports of black, unworked iron and steel sheets were likewise made subject to permit requirements. Exports of mercury from Czechoslovakia were made subject to export permit requirements in December 1936.

Italy.—Almost simultaneously with the recommendation of the League of Nations imposing on member countries restrictions on trade with Italy, the latter, in October 1935, prohibited publication of statistics on Italian foreign trade. Although the various countries had canceled the decrees restricting trade with Italy by July 1936, the official prohibition on publication of foreign trade statistics was not removed by December 1936. As a consequence, a comparative review of Italian trade cannot be made. However, Italy depends on foreign sources for most essential mineral raw materials except bauxite, mercury, zinc, gypsum, marble, and sulphur, of which it has exportable surplusses. Some antimony, copper, iron ore, lead, manganese, asbestos, barite, coal, fluorspar, graphite, magnesite, petroleum, potash, pyrites, and soapstone are produced, but the domestic reserves are wholly inadequate to meet requirements.

To insure an adequate supply of mineral raw materials for domestic consuming industries, the Italian Government issued decrees in December 1935 providing for the creation of three organizations to be responsible for the regulation and development of domestic mining activities and importation of essential minerals other than petroleum. Italian Mineral & Metal Corporation, a semiofficial agency, was established to aid in financing exploratory and development work in connection with domestic mineral deposits and to conduct mining operations when necessary. The Italian Coal Corporation, also a semigovernmental organization, was created to develop domestic coal deposits and to assist financially the principal coal producers of Istria and Sardinia, thus enabling them to increase production. The Mineral Products Board was created to regulate imports, domestic production, and distribution and to finance imports of minerals except petroleum and coal when necessary to maintain adequate supplies for national needs. This agency likewise exercises administrative functions for the afore-mentioned organizations. The fourth government agency, the Petroleum Board, was organized in October 1935 to supervise the activities of the Italian Petroleum Corporation and the Italian Corporation for Albanian Petroleum, which have served since 1926 as regulatory bodies for marketing petroleum products in Italy and for exploratory work.

These government organizations cooperate closely with the Fascist National Federation of Extractive Industries for mining companies and the Fascist National Federation of Mechanical and Metallurgical Industries for metallurgical and fabricating companies, both of which form a part of the National Confederation for Industry. Most Italian mining and metallurgical companies are now members of one or the other organization. Throughout 1936 these official and private agencies were actively concerned with the problem of increasing

domestic output of essential mineral raw materials and reducing imports of such products to a minimum. In Italy, as in Germany, the cost factor is considered as of secondary importance compared with attainment of the primary objective of national self-sufficiency.

Spain.—Although official Spanish production and foreign-trade statistics for 1936 are not available, shipments of those minerals of which the country produces an exportable surplus were maintained at a level approximating that for 1935. This fact is reflected by the tonnage of Spanish iron ore, mercury, pyrites, and pig lead received by principal consuming countries. France, Germany, the United Kingdom, and the United States account for more than 75 percent of the iron ore, 60 percent of the mercury, 55 percent of the pyrites, and 60 percent of the pig lead exported from Spain annually. Although Italy frequently has surpassed Spain in annual production of mercury, Spain has been the principal world producer since 1934. Of the total Spanish output in 1934, amounting to 31,799 flasks, the United Kingdom purchased 36 percent, the United States 20 percent, and France 8 percent. In 1935 and 1936 Germany became an important purchaser of Spanish mercury. Exports of mercury from Spain to France, Germany, the United Kingdom, and the United States in 1935 were approximately 41 percent greater than production during the year, which amounted to 35,560 flasks; the excess shipments were withdrawn from stocks. Exports to these countries in 1936 were about 23 percent below the 1935 level.

More than 50 percent of the crude pyrites produced in Spain is exported to France, Germany, the United Kingdom, and the United States. Exports to these four countries in 1934, which amounted to 1,050,790 metric tons, represent 51 percent of the total Spanish production during the year. Exports to these countries in 1935 totaled 1,456,858 metric tons and in 1936 decreased slightly to about 1,200,000 metric tons.

In 1936 exports of pig lead from Spain to France, the principal purchaser of Spanish lead, exceeded the tonnage shipped in 1934 and 1935, totaling 20,514 metric tons for the first 10 months of the year. Germany, the second largest importer of Spanish lead, purchased about 2,000 metric tons in 1936, or approximately the same quantity as in 1935. Italy is also an important buyer of Spanish pig lead, but as neither Spanish nor Italian foreign-trade statistics are available for 1936 no estimate of the tonnage involved can be made. Normally these three countries purchase approximately 60 percent of the total exports of lead from Spain.

Official import statistics indicate that Germany has become an outstanding buyer of Spanish iron ore, receiving 1,067,733 metric tons in 1936 compared with 1,320,596 tons in 1935 and 61,968 tons in 1934. French imports of iron ore from Spain during the first 10 months of 1936 were 43,462 tons compared with 35,259 tons in 1935. Although detailed figures covering imports into the United Kingdom are not available, there is evidence that the tonnage of Spanish ore shipped to the United Kingdom in 1936 was approximately the same as in 1935.

SOUTH AMERICA

Although national policies of many European countries are outstanding examples of evident determination to attain national self-sufficiency with regard to mineral raw materials, the tendency to

regulate or control international trade, as well as domestic industry, likewise has advanced in South American and Far Eastern countries. For example, in June 1936 a Bolivian decree empowered the exchange control board, in conjunction with the Central Bank of Bolivia, to exercise strict control over foreign trade by establishing import and export quotas and adopting measures tending to prohibit or restrict importation of products that are or may be produced in the country. Certain imports that are considered dispensable may be restricted temporarily or permanently at the discretion of the Board.

Under a Colombian decree, effective August 1, 1936, import licenses, previously obtained from the office of exchange and export control, are required for the importation of all merchandise into Colombia.

JAPAN

Japan and its possessions are little better off than Italy in domestic supplies of minerals. The known copper reserves are greater than in any other Far Eastern country, but they are inadequate to meet Japan's industrial requirements. From 1933 to 1935, 38 percent of Japan's apparent consumption of virgin refined copper was imported. Coal is probably the only primary industrial mineral of which Japan has sufficient reserves. During the period 1933–35, 92 percent of Japan's apparent consumption of crude petroleum and 80 percent of its pig-tin requirements was imported; moreover, 63 percent of its manganese ore was imported, although in the last few years that country has produced 2 to 3 percent of the world output of this mineral, so essential to its steel industry. Its reserves of iron ore are wholly inadequate to meet industrial demands. From 1933 to 1935, inclusive, 79 percent of its apparent consumption of iron ore was imported from countries other than Japanese possessions. In Japan, as in Italy, there are reserves of a few mineral raw materials, but output has been insufficient to meet domestic requirements. Japan's production of chrome ore in the past few years has been about 5 percent, its production of tungsten ore between 2 and 3 percent, and its production of zinc between 1 and 2 percent of the world output. In addition to these minerals it produces relatively small tonnages of antimony, mercury, platinum, asbestos, barite, china clay, fluorspar, graphite, mica, phosphate rock, pyrites, and sulphur, but the annual output is considerably less than current requirements.

Japan has promulgated a series of laws that regulate the domestic mining industry to a considerable extent, but to a greater degree these enactments enable manufacturers and consumers of imported raw materials to export finished, manufactured products to world markets under the most favorable competitive conditions. In 1931 the Japanese Government enacted a law which has two objectives for the control of principal or key industries of the country: (1) The strengthening and support of control measures, by which the Government is empowered to require nonmembers of a particular industrial union to abide by control agreements of such a union, provided the action is recommended by more than two-thirds of the total members of the union in question; and (2) the supervision of industrial control measures adopted by associations of industries, through which the Government is enabled to alter or abolish entirely industrial agreements considered adverse to the public interest or injurious to the best interests of the industry concerned or related industries.

The Export Indemnity Law of 1930 and a law for control of foreign trade enacted in 1934 were adopted to facilitate export financing to undeveloped markets, to protect Japanese export trade, and to equalize trade balances.

SERVICE OF BUREAU OF MINES

For a number of years the Bureau of Mines has collected, compiled, and published mineral-production statistics of foreign countries. For a detailed account of this phase of Bureau activity see Minerals Yearbook, 1935, page 21. Those who may wish to carry forward compilations heretofore prepared by the Bureau are referred to the the principal tables on world production presented in the following chapters in this volume.

Aluminum	Fluorspar	Petroleum
Antimony	Graphite	Phosphate rock
Arsenic	Gypsum	Platinum
Asbestos	Iron ore	Potash
Barite	Pig iron	Pyrites
Bauxite	Lead	Salt
Briquets	Magnesite	Sulphur
Cadmium	Manganese	Talc and soapstone
Chromite	Mercury	Tin
Coal	Mica	Titanium
Coke	Molybdenum	Tungsten
Copper	Nickel	Vanadium
Feldspar	Oil shale	Zinc

Principal sources.—Data used in this chapter have been obtained from official production and foreign-trade statistical publications of Belgium, France, Germany, Italy, Japan, U. S. S. R. (Russia), United Kingdom, and United States; monthly German Metal and Mineral Notes, American consulate general, Frankfort-on-Main, Germany; Weekly Reports of the German Institute of Business Research, Berlin, Germany; Foreign Tariffs and Trade Regulations, Bureau of Foreign and Domestic Commerce, Washington, D. C.; and press releases, The Department of State, Washington, D. C.

PART II. METALS

GOLD AND SILVER [1]

By Chas. W. Henderson and J. P. Dunlop

SUMMARY OUTLINE

DOMESTIC REFINERY PRODUCTION

The figures in the following table were obtained through cooperation between the United States Bureau of the Mint and the Bureau of Mines and were agreed upon after conference and adjustment between the two Bureaus.

The totals are based on bullion deposits in the United States mints and assay offices and on returns to the Bureau of the Mint from the smelting and refining companies. The distribution is adjusted by means of information collected by the Bureau of Mines directly from the producing mines and tabulated for the mine reports discussed later. The data for the total production and in part for the distribution are obtained from records of (1) the unrefined domestic gold and silver deposited in the United States mints and assay offices, (2) the domestic gold and silver in fine bars reported by private refineries, and (3) the unrefined domestic gold and silver contained in ore and matte exported for reduction. The last item is very small.

[1] Some of the data for 1936 are preliminary, as indicated; detailed statistics with final revisions will be released later

Approximate distribution of the production of gold and silver in the United States 1935–36, by producing States and Territories

[Figures supplied by U. S. Bureau of the Mint]

State or Territory	Gold [1]		Silver [2]	
	Fine ounces	Value	Fine ounces	Value
1935				
Alabama	2,303	$80,600	401	$288
Alaska	462,406	16,184,200	221,642	159,305
Arizona	215,806	7,553,200	5,764,831	4,143,472
California	870,120	30,454,200	1,064,616	765,193
Colorado	356,903	12,491,600	4,874,105	3,503,263
Georgia	1,026	35,900	95	68
Idaho	84,166	2,945,800	10,314,348	7,413,438
Illinois			2,627	1,888
Michigan			4,214	3,029
Missouri			132,497	95,232
Montana	138,271	4,839,500	8,066,604	5,797,872
Nevada	175,794	6,152,800	4,056,026	2,915,269
New Mexico	33,817	1,183,600	1,130,982	812,893
New York			23,528	16,911
North Carolina	2,177	76,200	7,730	5,556
Oregon	49,071	1,717,500	91,552	65,803
Pennsylvania	889	31,100	7,015	5,042
Philippine Islands	446,054	15,611,900	311,528	223,911
Puerto Rico	63	2,200	8	6
South Carolina	2,211	77,400	1,112	799
South Dakota	567,120	19,849,200	139,395	100,190
Tennessee	306	10,700	51,999	37,374
Texas	511	17,900	987,693	709,904
Utah	188,111	6,583,900	8,623,431	6,198,091
Virginia	246	8,600	13	9
Washington	8,383	293,400	45,448	32,666
Wyoming	3,529	123,500	1,014	729
	3,609,283	126,324,900	45,924,454	33,008,201
1936 [3]				
Alabama	4,923	172,305	1,100	847
Alaska	510,982	17,884,370	440,812	339,425
Arizona	315,284	11,034,940	8,664,767	6,671,871
California	1,042,915	36,502,025	1,824,572	1,404,920
Colorado	364,852	12,769,820	5,917,479	4,556,459
Georgia	398	13,930	20	15
Idaho	82,289	2,880,115	14,591,380	11,235,363
Illinois			4,867	3,748
Maryland	596	20,860	30	23
Missouri			163,724	126,067
Montana	179,768	6,291,880	11,357,827	8,745,527
Nevada	285,769	10,001,915	5,129,044	3,949,364
New Mexico	33,312	1,165,920	1,129,978	870,083
New York			21,000	16,170
North Carolina	1,807	63,245	8,376	6,450
Oklahoma	2	70	19	15
Oregon	59,765	2,091,775	87,573	67,431
Pennsylvania	1,114	38,990	8,670	6,676
Philippine Islands	599,453	20,980,855	472,962	364,181
Puerto Rico	482	16,870	187	144
South Carolina	474	16,590	72	55
South Dakota	589,229	20,623,015	137,981	106,245
Tennessee	190	6,650	44,663	34,391
Texas	593	20,755	1,323,482	1,019,081
Utah	225,415	7,889,525	10,638,483	8,191,632
Virginia	748	26,180	73	56
Washington	10,816	378,560	54,633	42,067
Wyoming	1,946	68,110	1,155	889
	4,313,122	150,959,270	62,024,929	47,759,195

[1] Gold valued at $35 per ounce.
[2] Silver valued per ounce, as follows: 1935, at $0.71875 (purchase rate for United States product); 1936, at 77 cents (approximate average purchase rate for United States product).
[3] Preliminary estimate.

In 1935, as in 1934 and 1933, more old gold was returned from industrial to monetary use than was issued to the arts and industries, a condition that has continued since 1932; returns for 1935 totaled

1,668,305 ounces and issues 740,843 ounces, a net return of 927,462 ounces. The total quantity of silver (new and old) used in the arts and industries was 41,192,023 ounces, 1,513,420 ounces more than in 1934. In addition to the gold and silver derived from foreign and domestic ore and bullion 1,668,305 ounces of gold and 35,903,107 ounces of silver were recovered from old or obsolete jewelry, silverware, dental waste, old film, and other material.

Gold and silver produced in the United States, 1792–1936 [1]

[The estimate for 1792–1872 is by R. W. Raymond, commissioner, and for the period since 1872 by the Director of the Mint]

Period	Gold		Silver	
	Fine ounces	Value	Fine ounces	Value
1792–1847	1,186,977	$24,537,000	309,500	$404,500
1848–72	58,279,781	1,204,750,000	118,568,200	157,749,900
1873–1936 [2]	180,428,816	3,900,094,470	3,266,996,042	2,472,378,189
	239,895,574	5,129,381,470	3,385,873,742	2,630,532,589

[1] Gold valued per fine ounce as follows: Prior to 1933, $20.67+; 1933, $25.56; 1934–36, $35.
[2] Subject to revision.

The average commercial value per fine ounce of silver for the total recorded domestic production is $0.777.

REGULATIONS AND EXECUTIVE ORDERS RELATING TO GOLD AND SILVER OF DOMESTIC ORIGIN

A complete account of the regulations pertaining to gold and silver is given in the chapter on Gold and Silver in Minerals Yearbook, 1934, pp. 25–46, issued by the United States Bureau of Mines.

Monetary relationships.—United States coinage laws show the development of the establishment of the value of $20.671834625323 per troy ounce of gold. The following table of laws gives the value of gold per troy ounce under different congressional acts, using the eagle ($10 gold coin), although no longer coined, as a basis.

Value of gold per troy ounce under different congressional acts

Date of law	Standard weight (grains)	Fineness (1000ths)	Fine gold content (grains)	Value per fine ounce troy (480 grains)	Value per grain
Apr. 2, 1792	270	916.6666+	247.5	$19.393939	$0.04040404
June 28, 1834	258	899.2248+	232.0	20 689656	.04310345
Jan. 18, 1837	258	900.0000	232.2	20.671835	.04306632
Mar. 4, 1900	258	900.0000	232.2	20.671835	.04306632
Jan. 31, 1934	152	900.0000	137.1	35.000000	.07291660

PRICES OF GOLD AND SILVER

Gold.—The United States Treasury buying price for gold remained at $35 per ounce throughout 1935 and 1936. The following table shows the monthly extremes of gold prices in London from January 1931 to December 1936, inclusive.

Gold prices in London, 1931–36

[Monthly extremes of gold prices in London per ounce, compiled from quotations published daily in American Metal Market]

Month	1931				1932				1933			
	High		Low		High		Low		High		Low	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d*
January	85	1¼	84	11½	122	9	117	11	123	8	121	1½
February	84	11½	84	10¾	120	9	118	5	122	0	119	9
March	84	11½	84	9¾	118	10	108	11	121	11½	118	11
April	84	10½	84	9¾	113	5	108	4	122	9	118	0
May	84	11½	84	9¾	113	7	112	5	124	8	122	5
June	85	0¼	84	9¾	114	8	112	2	124	5	122	0
July	84	11½	84	10⅛	117	8	115	0	124	10	122	4½
August	84	11½	84	9¾	119	3	117	0	129	7	124	0
September [1]	114	9	84	9¾	119	5	117	11	133	9	127	7
October	108	6	103	8	125	8	119	2	134	8	128	1
November	117	11	108	2	130	8	123	2½	133	3	125	1½
December	126	10	118	9	130	0½	123	4½	127	0	124	8
Year	126	10	84	9¾	130	8	108	4	134	8	118	0

Month	1934				1935				1936			
	High		Low		High		Low		High		Low	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
January	133	1	126	8	142	4	140	10½	141	4	140	7½
February	140	0	134	9	144	1	142	1	141	2	140	6
March	137	2	135	5½	149	4	143	8	141	1½	140	8
April	138	8	134	3	145	8½	143	4	141	0½	140	7
May	137	0½	135	10	145	0	141	0	140	10	139	3
June	138	2½	137	1½	142	0	140	7	139	4	138	3
July	130	0½	137	5	141	7	140	5	139	1	138	7
August	140	11½	137	10	140	11	139	9½	138	7½	138	2
September [1]	141	7	140	3½	141	6½	140	3	140	9	137	2½
October	143	3	139	6	142	0	141	3½	142	4½	140	5½
November	139	10	139	0½	141	7	140	11	142	8½	141	10½
December	141	0	139	9½	141	3	140	11	142	1	141	4
Year	143	3	126	8	149	4	139	9½	142	8½	137	2½

[1] British gold standard suspended Sept. 21, 1931.

Silver.—On January 1, 1935, the United States Treasury buying price for newly mined silver stood at $0.64646464+ (one-half of the coinage value of $1.29292929+). On April 10, 1935, the Treasury raised the price to $0.7111+ and on April 24, to $0.7757+; this price was maintained throughout the remainder of 1935 and all of 1936 and was in effect when this report was written (June 12, 1937). The extreme monthly prices of silver in New York for 1935 and 1936, by months, have been as follows:

Silver prices in New York, 1935–36, in cents per ounce

[Extreme monthly prices (official) of silver in New York per fine ounce, compiled from quotations published daily in American Metal Market]

Month	1935		1936		Month	1935		1936	
	High	Low	High	Low		High	Low	High	Low
January	55	53⅞	49¾	44¾	August	67¾	65⅜	44¾	44¾
February	56½	53½	44¾	44¾	September	65⅜	65⅜	44¾	44¾
March	61¼	56⅞	44¾	44¾	October	65⅜	65⅜	44¾	44¾
April	81	61¼	45¾	44¾	November	65⅜	65⅜	47½	44¾
May	77	71¼	45¾	44¾	December	65⅜	49¾	46½	44⅞
June	74	69½	44¾	44¾					
July	69¾	67¾	44¾	44¾	Year	81	49¾	49¾	44¾

The following tables show (1) the price of bar silver per fine ounce in New York in 1935 and in the first 6 months of 1936, by months; (2) the yearly average price, 1930–35; and (3) the highest, lowest, and average price of silver in New York since 1874.

Price of fine bar silver (other than domestic) per ounce in New York in 1935 and first 6 months of 1936, by months

1935

January	$0.54730	August	$0.66644
February	.54914	September	.65687
March	.59360	October	.65687
April	.68100	November	.65687
May	.74668	December	.58732
June	.72252		
July	.68528	Average for year	.64582

1936

January	$0.47562	May	$0.45181
February	.45062	June	.45062
March	.45062		
April	.45204	Average for 6 months	.45522

Price of fine bar silver per ounce in New York, 1930–35 [1]

1930	$0.385	1933	$0.350
1931	.290	1934	.483
1932	.282	1935	.646

[1] 1930–33: Average for all silver; 1934–35: Average for silver other than domestic.

Highest, lowest, and average price of silver in New York since 1874, per fine ounce, being the asked price to and including 1917, and thereafter taken at the mean of the bid and asked prices

Calendar year	Quotation			Calendar year	Quotation		
	High	Low	Average		High	Low	Average
1874	$1.29375	$1.25500	$1.27195	1905	$0.66500	$0.55625	$0.61008
1875	1.26125	1.21000	1.23883	1906	.72375	.63125	.67379
1876	1.26000	1.03500	1.14950	1907	.71000	.52750	.65978
1877	1.26000	1.16000	1.19408	1908	.58875	.48250	.53496
1878	1.20750	1.08500	1.15429	1909	.54500	.50750	.52163
1879	1.16750	1.06500	1.12088	1910	.57625	.50750	.54245
1880	1 15000	1.11250	1.13931	1911	.57500	.52125	.54002
1881	1.14500	1.11000	1.12823	1912	.65625	.55250	.62006
1882	1.15000	1.09000	1.13855	1913	.65125	.58000	.61241
1883	1.11750	1.09500	1.10874	1914	.60875	.49000	.56331
1884	1.13250	1.08000	1.11161	1915	.58000	.47750	.51062
1885	1.09500	1.02750	1.06428	1916	.79125	.57250	.67151
1886	1.03500	.92500	.99880	1917	1.16500	.73125	.84000
1887	1.03500	.95000	.97899	1918	1.01937	.88937	.98445
1888	.97750	.92000	.94300	1919	1.38250	1.01375	1.12087
1889	.97250	.92500	.93634	1920	1.37875	.60375	1.01940
1890	1.20500	.95750	1.05329	1921	.73813	.53188	.63096
1891	1.07500	.94750	.99033	1922	.74188	.62875	.67934
1892	.95250	.83000	.87552	1923	.69000	.62875	.65239
1893	.85000	.65000	.78219	1924	.72375	.63000	.67111
1894	.70000	.59500	.64043	1925	.73187	.66812	.69406
1895	.69000	.60000	.66268	1926	.68937	.51812	.62428
1896	.70250	.65625	.68195	1927	.60312	54187	.56680
1897	.66125	.52750	.60774	1928	.63937	.56812	.58488
1898	.62250	.55125	.59064	1929	.57812	.46812	.53306
1899	.64750	.58625	.60507	1930	.47187	.31062	.38466
1900	.65750	.59750	.62065	1931	.37562	.26062	.29013
1901	.64500	.54750	.59703	1932	.31312	.24562	.28204
1902	.56875	.47375	.52815	1933 [1]	.45312	.24812	.34997
1903	.62375	.47500	.54208	1934	.56062	.42062	.48283
1904	.62500	.53375	.57843	1935	.81312	.50062	.64582

[1] Quotations are in depreciated currency after early March 1933.

UNITED STATES MONETARY STOCK

The Federal Reserve Bulletin of the Federal Reserve Board for May 1937 analyzes the changes in monetary gold stock of the United States from December 31, 1932, to April 30, 1937, inclusive, as follows:

Analysis of changes in monetary gold stock, Dec. 31, 1932, to Apr. 30, 1937

[In millions of dollars]

Year or month	Gold stock at end of year or month		Increase in total gold stock	Net gold import	Net release from earmark [1]	Other factors [2]
	Total	Inactive account				
	\$1=25 8/10 grains of gold 9/10 fine; i. e., an ounce of fine gold=\$20.67					
1932	4,226		52.9	−446.2	457.5	41.6
1933	4,036		−190.4	−173.5	−58.0	41.1
1934:						
January	4,033		−2.1	−2.8	12.2	−11.6
	\$1=15 5/21 grains of gold 9/10 fine; i. e., an ounce of fine gold=\$35					
February	7,438		3,405.0	452.6	68.7	2,883.8
March	7,695		256.8	237.3	−.8	20.3
April	7,757		61.5	54.7	−1.1	7.9
May	7,779		22.4	33.6	.5	−11.6
June	7,856		77.1	63.7	1.0	12.5
July	7,931		74.4	52.3	.6	21.4
August	7,978		47.4	37.2	−1.1	11.2
September	7,978		.4	−18.7	2.4	16.6
October	8,002		23.5	10.8	.3	12.4
November	8,132		129.9	120.9	−.1	9.1
December	8,238		106.2	92.1	.1	14.1
Year 1934	8,238		4,202.5	1,133.9	82.6	2,986.1
1935:						
January	8,391		153.3	149.4	1.1	2.8
February	8,527		135.3	122.8	.2	12.3
March	8,567		40.4	13.0	−.7	28.1
April	8,710		143.4	148.6	−2.3	−3.0
May	8,858		148.1	140.0	−1.5	9.6
June	9,116		257.1	230.4	1.0	25.8
July	9,144		27.9	16.2	−.4	12.1
August	9,203		59.5	46.0	1.4	12.2
September	9,368		165.0	156.7	1.0	7.3
October	9,693		325.2	315.3	−1.9	11.8
November	9,920		226.7	210.6	.6	15.5
December	10,125		205.2	190.0	1.3	13.9
Year 1935	10,125		1,887.2	1,739.0	.2	148.0
1936:						
January	10,182		57.2	45.6	−1.7	13.3
February	10,167		−15.5	−16.6	−9.5	10.6
March	10,184		17.2	5.5	1.0	10.7
April	10,225		41.0	28.1	−.2	13.1
May	10,402		176.7	170.0	−3.2	10.0
June	10,608		206.6	277.8	−24.8	−46.4
July	10,648		39.2	15.4	2.3	21.5
August	10,716		68.4	67.5	−11.9	12.9
September	10,845		129.0	171.8	−28.8	−14.0
October	11,045		199.7	218.8	−11.3	−7.9
November	11,184		139.5	75.8	3.0	60.7
December	11,258	26.5	73.3	57.0	−.7	17.0
Year 1936	11,258	26.5	1,132.5	1,116.6	−85.9	101.7
1937:						
January	11,358	126.5	100.1	121.3	−48.3	27.1
February	11,436	204.7	78.2	120.3	−8.0	−34.1
March	11,574	342.5	137.9	154.3	−.4	−16.0
April	11,799	568.0	225.6	215.8	7.2	2.5

[1] Gold released from earmark at Federal Reserve banks less gold placed under earmark (with allowance when necessary for changes in gold earmarked abroad for account of Federal Reserve banks).

[2] Figures are derived from preceding columns and indicate net result of such factors as domestic production, movements into and out of nonmonetary use or unreported holdings, imports and exports that do not affect gold stock during the month or year, and increment resulting from reduction in weight of gold dollar.

Daily statement of the United States Treasury, June 4, 1937

CURRENT ASSETS AND LIABILITIES

GOLD

Assets		Liabilities		
Gold	$12,056,810,044.31	Gold certificates:		
		Outstanding (outside of Treasury)		$2,904,402,139.00
		Gold certificate fund—Board of Governors, Federal Reserve System		6,022,942,436.78
		Redemption fund—Federal Reserve notes		9,970,351.75
		Gold reserve		156,039,430.93
		NOTE.—Reserve against $346,681,016 of United States notes and $1,172,472 of Treasury notes of 1890 are also secured by silver dollars in the Treasury.		
		Exchange stabilization fund		1,800,000,000.00
				10,893,354,358.46
		Gold in general fund:		
		Inactive	$825,475,985.16	
		Balance of increment resulting from reduction in weight of the gold dollar	140,913,892.78	
		In working balance	197,065,807.91	
				1,163,455,685.85
Total	12,056,810,044.31	Total		12,056,810,044.31

SILVER

Assets		Liabilities	
Silver	$828,181,751.06	Silver certificates outstanding	$1,286,330,829.00
Silver dollars	505,783,432.00	Treasury notes of 1890 outstanding	1,172,472.00
		Silver in general fund	46,461,882.06
Total	1,333,965,183.06	Total	1,333,965,183.06

IMPORTS AND EXPORTS [1]

Value of gold and silver imported into and exported from the United States, 1935–3 by classes

	Imports	Exports	Excess of imports over exports
1935			
Gold:			
Contained in ore and base bullion	$72,718,366	$963,938	$71,754,428
Bullion refined	1,578,635,040	949,040	1,577,686,000
United States coin	5,375,326		5,375,326
Foreign coin	84,250,383	47,341	84,203,042
	1,740,979,115	1,960,319	1,739,018,796
Silver:			
Contained in ore and base bullion	30,257,757	449,565	29,808,192
Bullion refined	303,172,292	3,215,933	299,956,359
United States coin	1,418,022	872,748	545,274
Foreign coin	19,682,930	14,263,045	5,419,885
	354,531,001	18,801,291	335,729,710
1936			
Gold:			
Contained in ore and base bullion	73,705,464	842,573	72,862,891
Bullion refined	1,067,679,844	26,690,938	1,040,988,906
United States coin	1,810	10	1,800
Foreign coin	2,730,294		2,730,294
	1,144,117,412	27,533,521	1,116,583,891
Silver:			
Contained in ore and base bullion	19,574,346	530,545	19,043,801
Bullion refined	99,964,158	1,241,306	98,722,852
United States coin	340,377	29,771	310,606
Foreign coin	62,937,318	1,163,871	61,773,447
	182,816,199	2,965,493	179,850,706

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

153336—37——9

DOMESTIC SUPPLY

The domestic supply of new gold comes chiefly from dry and siliceous ore and from placer gravel worked largely by dredges. These two sources yielded 90.2 percent of the domestic gold in 1915, 79.86 percent in 1930, 86.5 percent in 1931, 92.9 percent in 1932, 92.94 percent in 1933, 92.68 percent in 1934, and 90.55 percent in 1935. The proportionate output of gold from copper ore was 7.2 percent in 1915, 16.4 percent in 1926, 22.2 percent in 1929, 9.65 percent in 1931, 5.25 percent in 1934, and 7.01 percent in 1935.

In 1915 dry and siliceous ore yielded 36 percent of the total silver; copper ore, 26 percent; lead ore, 27 percent; and lead-zinc ore, only 9 percent. In 1935 dry and siliceous ore yielded 40.02 percent; copper ore, 26.15 percent; lead ore, 6.89 percent; and lead-zinc ore, 26.60 percent.

WORLD PRODUCTION

GOLD

According to the Bureau of the Mint, the estimated quantity of gold produced in the world from 1860 to 1935, inclusive, is 975,246,364 fine ounces. For 1935 alone it is estimated at 30,001,209 ounces, an increase of 2,628,835 ounces over 1934.

In a Bureau of Mines publication,[2] the world output of gold from 1493 to 1927, inclusive, is estimated as approximately 1,003,560,000 ounces, of which 51.5 percent was produced from 1901 to 1927. Adding to this the production (188,153,881 ounces) from 1928 to 1935, inclusive, makes an estimated total from 1493 to 1935 of approximately 1,191,714,000 ounces.

The following table shows the output of gold by countries from 1931 to 1935, as estimated by the Bureau of the Mint.

World production of gold, 1931–35, by countries, in fine ounces

Country	1931	1932	1933	1934	1935
North America:					
Canada	2,695,219	3,050,581	2,949,309	2,972,143	3,283,121
Central America and West Indies	67,725	82,238	87,075	130,000	135,000
Mexico	623,003	584,487	637,727	661,405	682,338
Newfoundland			15,689	12,000	12,956
United States [1]	2,213,741	2,219,304	2,276,711	2,741,706	3,163,229
	5,599,688	5,936,610	5,966,511	6,517,254	7,276,644
South America:					
Argentina		964	964	1,200	9,902
Bolivia	17,328	12,281	32,889	64,301	64,301
Brazil	115,473	115,451	126,000	113,621	120,597
Chile	21,380	38,098	147,054	237,658	264,407
Colombia	194,268	248,230	298,246	344,140	328,999
Ecuador	59,616	65,629	60,667	66,427	71,512
Guiana:					
British	6,944	18,714	31,056	25,000	30,000
French	43,531	45,010	42,456	47,454	11,349
Netherland (Surinam)	4,597	8,970	12,378	11,896	47,390
Peru	73,688	55,555	84,072	98,864	98,863
Uruguay			18		32
Venezuela	42,309	77,087	95,710	109,055	112,390
	579,134	685,989	931,510	1,119,616	1,159,742

[1] Philippine Islands excluded.

[2] Ridgway, Robert H., Summarized Data of Gold Production: Econ. Paper 6, Bureau of Mines, 1929, 63 pp.

World production of gold, 1931–35, by countries, in fine ounces—Continued

Country	1931	1932	1933	1934	1935
Europe:					
Austria		257			
Bulgaria				643	643
Czechoslovakia	1,093	2,283	2,283	7,588	7,588
France	42,663	43,402	57,870	101,500	101,500
Germany	4,115	2,186	5,498	5,755	5,948
Great Britain		6	64	51	161
Greece	483	482	482		
Hungary			2,861	1,833	1,479
Italy	2,165	1,832	2,565	2,476	2,476
Rumania	96,482	109,631	120,000	120,019	154,323
Spain	483	484	7,716	7,588	3,858
Sweden	90,000	90,000	135,930	252,480	218,721
U. S. S. R. (Russia)	1,700,960	1,990,085	2,667,100	3,858,089	4,784,030
Yugoslavia	21,862	47,582	70,344	71,342	74,172
	1,960,306	2,288,230	3,072,713	4,429,364	5,354,899
Asia:					
China	96,750	96,751	150,000	154,966	154,966
Chosen	208,626	208,626	369,991	417,960	523,948
Cyprus				6,872	6,872
East Indies, Netherland	100,083	77,964	78,832	66,295	68,256
Federated Malay States	27,021	27,159	31,107	31,777	30,567
India, British	330,484	329,632	336,106	322,193	324,816
Indo-china	289	289	161	7,073	8,616
Japan	434,037	434,037	433,800	471,394	589,034
Philippine Islands	181,981	229,728	279,535	340,316	451,814
Sarawak	5,901	8,178	18,712	28,842	28,549
Taiwan	92,430	92,430	92,430	73,180	73,180
Turkey	900	900			
	1,478,502	1,505,694	1,790,674	1,920,868	2,260,618
Africa	11,927,961	12,735,979	12,448,275	12,128,261	12,570,089
Australasia	783,934	998,267	1,157,712	1,257,011	1,379,217
	22,329,525	24,150,761	25,367,395	27,372,374	30,001,209

An estimate of world production of gold in 1936 follows:

World production of gold in 1936, in fine ounces, by countries

	Fine ounces		*Fine ounces*
Africa	13,400,000	Canada	3,720,000
Australasia	1,800,000	Newfoundland	16,000
Asia (including Philippine Islands)	2,500,000	Mexico	760,000
Europe	7,900,000	South America	1,300,000
United States (excluding Philippine Islands)	3,769,000		35,165,000

SILVER

The Bureau of the Mint estimates the world production of silver from 1860 to 1935, inclusive, as 10,755,949,903 fine ounces. The output was 25,550,429 ounces more in 1935 than in 1934.

The following table shows the output of silver by countries, 1931 to 1935, inclusive, as estimated by the Bureau of the Mint:

World production of silver, 1931–35, by countries, in fine ounces

Country	1931	1932	1933	1934	1935
North America:					
Canada	20,558,200	18,356,393	15,187,063	16,415,282	16,624,426
Central America and West Indies	4,000,000	4,300,000	4,800,000	3,500,000	3,500,000
Mexico	86,064,500	69,303,054	68,101,062	74,145,012	75,589,199
Newfoundland	(1)	(1)	1,208,280	1,150,000	1,124,380
United States [2]	30,822,000	23,831,642	22,821,257	32,486,879	45,612,926
	141,444,700	115,791,089	112,117,662	127,697,173	142,450,931
South America:					
Argentina		50,154	50,154	60,000	49,994
Bolivia	5,772,300	4,115,200	5,469,069	5,216,297	5,800,000
Brazil	10,000	10,000	10,000	10,000	10,000
Chile	320,200	103,780	256,621	1,053,097	1,050,043
Colombia	40,000	50,000	107,992	127,461	132,975
Ecuador	104,800	114,167	113,200	110,815	80,658
Guiana	6,000	6,000	6,000	6,000	6,000
Peru	10,942,500	6,735,360	6,760,534	10,381,314	17,432,968
Venezuela	4,200	6,000	6,000	7,000	7,000
	17,200,000	11,190,661	12,779,570	16,971,984	24,569,638
Europe:					
Austria	10,200	27,938		14,017	11,863
Czechoslovakia	899,300	947,139	947,139	971,370	971,370
France	652,000	643,000	643,000	303,985	303,985
Germany	5,784,600	5,993,499	6,320,690	5,944,029	6,257,788
Great Britain	34,000	16,043	37,551	138,955	92,851
Greece	192,900	192,900	192,900	255,000	180,000
Hungary			15,593	9,163	4,983
Italy	719,300	801,499	377,592	1,290,820	1,290,820
Norway	297,400	292,565	241,125	176,829	225,055
Poland	558,700	69,283	41,377	21,155	32,311
Rumania	155,800	173,031	173,031	388,027	289,357
Spain	3,098,700	3,374,335	2,929,508	1,788,289	861,640
Sweden	80,000	80,000	244,822	519,717	608,967
U. S. S. R. (Russia)	350,000	400,000	981,000	1,322,000	2,200,000
Yugoslavia	94,700	133,230	1,624,000	1,748,000	1,753,534
	12,927,600	13,144,462	14,769,328	14,891,356	15,084,524
Asia:					
Burma	5,898,000	6,001,000	6,050,000	5,787,524	5,800,000
China	60,000	60,000	60,000	146,614	146,614
Chosen	203,500	209,332	702,976	964,522	1,464,986
Cyprus				44,536	44,536
East Indies, Netherland	1,473,100	842,362	860,463	771,361	701,722
India, British	25,000	25,737	30,241	30,000	31,000
Indo-China	1,600	2,724	1,607	3,601	3,633
Japan	6,183,300	6,360,643	5,958,842	6,882,156	8,230,751
Philippine Islands	97,100	149,131	181,372	212,613	322,022
Taiwan	17,200	17,713	17,713	16,075	16,075
Turkey	200,000	200,000			
	14,158,800	13,868,642	13,863,214	14,859,002	16,761,339
Africa:					
Algeria	150,000	58,899	128,139	100,000	50,000
Bechuanaland	700	1,672	622	957	1,758
Belgian Congo	15,000	18,000	2,646,713	3,399,619	3,793,788
British West Africa (Gold Coast, Ashanti, Nigeria, Sierra Leone)	252,900	86,402	117,480	82,400	139,200
Eritrea			96		
Portuguese East Africa	100	257	224	763	725
Rhodesia	76,500	114,893	112,459	128,568	132,238
Tanganyika, Uganda, Kenya Colony	1,900	4,431	5,505	7,228	10,207
Transvaal, Cape Colony, Natal	1,063,000	1,120,668	1,065,011	1,002,203	1,042,203
	1,560,100	1,405,222	4,076,249	4,721,738	5,170,119
Australasia	8,628,800	9,492,726	11,553,031	11,256,903	11,913,034
	195,620,000	164,892,802	169,159,054	190,398,156	215,949,585

[1] Some production. Not recorded in report of Bureau of the Mint.
[2] Philippine Islands excluded.

An estimate of world production of silver in 1936 follows:

World production of silver in 1936, in fine ounces, by countries

	Fine ounces		Fine ounces
Mexico	78,000,000	Europe	18,000,000
United States (excluding Philippine Islands)	60,721,000	Asia (including Philippine Islands)	19,000,000
Canada	18,100,000	Australasia	14,000,000
Central America and West Indies	4,000,000	Africa	4,800,000
Newfoundland	1,250,000		249,171,000
South America	31,300,000		

The following table giving the average commercial ratio of silver to gold each calendar year since 1687 is an interesting complement to the world-production tables for gold and silver:

Average commercial ratio of silver to gold in each calendar year, 1687–1935

Year	Ratio	Year	Ratio	Year	Ratio	Year	Ratio	Year	Ratio	Year	Ratio
1687	14.94	1729	14.92	1771	14.66	1813	16.25	1855	15.38	1896	30.59
1688	14.94	1730	14.81	1772	14.52	1814	15.04	1856	15.38	1897	34.20
1689	15.02	1731	14.94	1773	14.62	1815	15.26	1857	15.27	1898	35.03
1690	15.02	1732	15.09	1774	14.62	1816	15.28	1858	15.38	1899	34.36
1691	14.98	1733	15.18	1775	14.72	1817	15.11	1859	15.19	1900	33.33
1692	14.92	1734	15.39	1776	14.55	1818	15.35	1860	15.29	1901	34.68
1693	14.83	1735	15.41	1777	14.54	1819	15.33	1861	15.50	1902	39.15
1694	14.87	1736	15.18	1778	14.68	1820	15.62	1862	15.35	1903	38.10
1695	15.02	1737	15.02	1779	14.80	1821	15.95	1863	15.37	1904	35.70
1696	15.00	1738	14.91	1780	14.72	1822	15.80	1864	15.37	1905	33.87
1697	15.20	1739	14.91	1781	14.78	1823	15.84	1865	15.44	1906	30.54
1698	15.07	1740	14.94	1782	14.42	1824	15.82	1866	15.43	1907	31.24
1699	14.94	1741	14.92	1783	14.48	1825	15.70	1867	15.57	1908	38.64
1700	14.81	1742	14.85	1784	14.70	1826	15.76	1868	15.59	1909	39.74
1701	15.07	1743	14.85	1785	14.92	1827	15.74	1869	15.60	1910	38.22
1702	15.52	1744	14.87	1786	14.96	1828	15.78	1870	15.57	1911	38.33
1703	15.17	1745	14.98	1787	14.92	1829	15.78	1871	15.57	1912	33.62
1704	15.22	1746	15.13	1788	14.65	1830	15.82	1872	15.63	1913	34.19
1705	15.11	1747	15.26	1789	14.75	1831	17.72	1873	15.93	1914	37.37
1706	15.27	1748	15.11	1790	15.04	1832	15.73	1874	16.16	1915	40.48
1707	15.44	1749	14.80	1791	15.05	1833	15.93	1875	16.64	1916	30.78
1708	15.41	1750	14.55	1792	15.17	1834	15.73	1876	17.75	1917	24.61
1709	15.31	1751	14.39	1793	15.00	1835	15.80	1877	17.20	1918	21.00
1710	15.22	1752	14.50	1794	15.37	1836	15.72	1878	17.92	1919	18.44
1711	15.29	1753	14.54	1795	15.55	1837	15.83	1879	18.39	1920	20.28
1712	15.31	1754	14.48	1796	15.65	1838	15.85	1880	18.05	1921	32.76
1713	15.24	1755	14.68	1797	15.41	1839	15.62	1881	18.25	1922	30.43
1714	15.13	1756	14.94	1798	15.59	1840	15.62	1882	18.20	1923	31.69
1715	15.11	1757	14.87	1799	15.74	1841	15.70	1883	18.64	1924	30.80
1716	15.09	1758	14.85	1800	15.68	1842	15.87	1884	18.61	1925	29.78
1717	15.13	1759	14.15	1801	15.46	1843	15.93	1885	19.41	1926	33.11
1718	15.11	1760	14.14	1802	15.26	1844	15.85	1886	20.78	1927	36.47
1719	15.09	1761	14.54	1803	15.41	1845	15.92	1887	21.10	1928	35.34
1720	15.04	1762	15.27	1804	15.41	1846	15.90	1888	22.00	1929	38.78
1721	15.05	1763	14.99	1805	15.79	1847	15.80	1889	22.10	1930	53.74
1722	15.17	1764	14.70	1806	15.52	1848	15.85	1890	19.75	1931	71.25
1723	15.20	1765	14.83	1807	15.43	1849	15.78	1891	20.92	1932	73.29
1724	15.11	1766	14.80	1808	16.08	1850	15.70	1892	23.72	1933	59.06
1725	15.11	1767	14.85	1809	15.96	1851	15.46	1893	26.49	1934	72.49
1726	15.15	1768	14.80	1810	15.77	1852	15.59	1894	32.56	1935	54.74
1727	15.24	1769	14.72	1811	15.53	1853	15.33	1895	31.60		
1728	15.11	1770	14.62	1812	16.11	1854	15.33				

MINE REPORT

METHOD OF COLLECTING STATISTICS

The first table in this report presents the official refinery figures of the production of gold and silver in the United States in 1935 and 1936, as agreed upon by the Bureau of the Mint and the Bureau of Mines. With the comparatively unimportant exceptions of domestic gold and silver contained in ore and matte exported for reduction during the

year, these figures record the production of gold and silver bullion from domestic ore in marketable form as metals, either refined or unrefined.

To trace the gold and silver produced back to its source by States, counties, and mining districts, the Bureau of Mines systematically investigates the "mine production" of ores containing gold and silver and the output of the placer mines, the total being classified by methods of production and by kinds of ore, as well as by mining districts. The resulting figures form the basis of the mine reports.

Of the two plans for ascertaining the production of gold and silver, one is a measure of the metallurgic industry and the other of the mining industry; one reports the metal actually recovered in marketable form and the other the mine output and its recoverable content. The two methods will not produce identical results, but the figures for a period of years sufficiently long to compensate for overlap or lag should agree within allowable limits of error.

Gold and silver produced in the United States, 1905–35, according to mint and mine returns

Year	Mint		Mine	
	Gold [1]	Silver	Gold [1]	Silver
		Fine ounces		*Fine ounces*
1905–31	$1,929,861,500	1,636,641,604	$1,917,814,501	1,626,080,695
1932	50,626,000	23,980,773	53,218,073	22,899,865
1933	65,337,600	23,002,629	67,191,498	23,317,159
1934	108,191,400	32,725,353	109,014,594	32,995,017
1935	126,324,900	45,924,454	129,109,115	48,840,669
Total, 1905–35	2,280,341,400	1,762,274,813	2,276,347,781	1,754,133,405
Fine ounces of gold	105,062,800		104,785,467	

[1] Gold valued per fine ounce as follows: Prior to 1933, at $20.67+; 1933, at $25.56; 1934, mint at $35 and mine at $34.95; 1935, at $35.

According to mint reports, these figures show a total excess of gold for the 31 years of 277,333 ounces (a difference of 0.26 percent) and a total excess of silver of 8,141,408 ounces (a difference of 0.46 percent).

UNITS OF MEASUREMENT

In the measurement of ores and concentrates the short ton of 2,000 pounds is used.

Throughout 1932 and earlier years the price of gold was fixed by law at $20.67+ per fine ounce, and in 1933 the legal coinage value was continued at $20.67+. The average weighted price per fine ounce, as computed by the Bureau of Mines, was $25.56 for the year 1933, $34.95 for 1934, and $35 for 1935 and 1936.

The annual average prices for domestic silver from 1931 to 1936 are as follows: 1931, $0.290; 1932, $0.282; 1933, $0.350; 1934, $0.64646464+; 1935, $0.71875; 1936, $0.7745.

MINES PRODUCING

LEADING GOLD PRODUCERS

The output of the 25 largest gold producers in the United States (Philippine Islands and Puerto Rico excluded) in 1936, none of which

produced less than 17,500 ounces, was 2,022,500 fine ounces (53.7 percent of the total); in 1935 none of the group produced less than 13,800 ounces, and the total output was 1,795,000 ounces (55.5 percent of the total); and in 1934, none produced less than 15,600 ounces, and the total group output was 1,660,900 ounces (60 percent of the total). The successive decreases in 1935 and 1936 from 1934 in the proportion of the total gold produced by the 25 largest operators indicate, as anticipated, that lower-grade gold ores were treated at the larger lode mines and that new mines and smaller mines were responsible for a large part of the increase in output of gold. Operators of gold dredges increased their output 89,558 ounces in 1936 over 1935 compared with only 2,595 ounces in 1935 over 1934. The average recovery of gold per ton of dry and siliceous ores decreased from 0.156 ounce in 1934 to 0.154 ounce in 1935.

The Homestake lode mine in South Dakota was the largest producer of gold in both 1935 and 1936, as for many years past. In 1935 the Golden Cycle Corporation (custom mill) in Colorado was the second largest producer, but in 1936 second place was taken by the Phelps Dodge Corporation (combined output of company mines in three copper-producing districts). The Fairbanks Exploration Co. in Alaska (gold derived from dredging gravel) was the third largest producer in both years.

Larger producers of gold in the United States, 1935–36, in order of output [1]

1935

Rank	Operator	State	Mining district	Source of gold
1	Homestake Mining Co.	South Dakota	Whitewood	Dry and siliceous ore.
2	Golden Cycle Corporation [2]	Colorado	Cripple Creek	Do.
3	Fairbanks Exploration Co.	Alaska	Fairbanks	Dredging gravel.
4	Alaska Juneau Gold Mining Co.	do	Juneau	Dry and siliceous ore.
5	Empire Star Mines Co., Ltd.	California	Grass Valley	Do.
6	Phelps Dodge Corporation (Copper Queen and United Verde).	Arizona	Warren and Verde	Copper ore.
7	Idaho-Maryland Mines Co.	California	Grass Valley	Dry and siliceous ore.
8	Utah Copper Co.	Utah	West Mountain	Copper ore.
9	Natomas Co.	California	Folsom	Dredging gravel.
10	Yuba Consolidated Gold Fields.	do	Yuba River and Snelling.	Do.
11	Hammon Consolidated Gold Fields.	Alaska	Nome	Do.
12	The Mountain Copper Co., Ltd.	California	Iron Mountain	Dry and siliceous ore.
13	Capital Dredging Co.	do	Folsom	Dredging gravel.
14	London Gold Mines Co.	Colorado	Mosquito	Dry and siliceous ore.
15	Nevada Consolidated Copper Corporation.	Nevada	Robinson	Copper ore.
16	United States Smelting, Refining & Mining Co.	Utah	West Mountain	Lead ore, lead-zinc ore, and siliceous ore.
17	The Argonaut Mining Co., Ltd.	California	Jackson	Dry and siliceous ore.
18	St. Joseph Lead Co.	Idaho	Middle Boise	Do.
19	Snelling Gold Dredging Co.	California	Snelling	Dredging gravel.
20	Carson Hill Gold Mining Corporation.	do	Mother Lode	Dry and siliceous ore.
21	American Metal Co. (Pecos mine).	New Mexico	Willow Creek	Lead-zinc ores.
22	Willow Creek Mines, Inc.	Alaska	do	Dry and siliceous ore.
23	Cardinal Gold Mining Co.	California	Chidago	Do.
24	W. A. Ellis, Inc.	Colorado	Mosquito	Do.
25	Original Sixteen to One Mine, Inc.	California	Alleghany	Do.

[1] Philippine Islands excluded.
[2] Custom mill. Includes mainly ore from Cresson, Portland, Ajax, and other mines in Cripple Creek district, Colorado, but also from other districts in Colorado.

Larger producers of gold in the United States, 1935–36, in order of output—Con.

1936

Rank	Operator	State	Mining district	Source of gold
1	Homestake Mining Co.	South Dakota	Whitewood	Dry and siliceous ore.
2	Phelps Dodge Corporation	Arizona	Warren, Verde, Ajo	Copper ore.
3	Fairbanks Exploration Co.	Alaska	Fairbanks	Dredging gravel.
4	Alaska Juneau Mining Co.	do	Juneau	Dry and siliceous ore.
5	Golden Cycle Corporation [1]	Colorado	Cripple Creek, etc.	Do.
6	Empire Star Mines Co., Ltd.	California	Grass Valley	Do.
7	Utah Copper Co.	Utah	West Mountain	Copper ore.
8	Idaho-Maryland Mines Corporation.	California	Grass Valley	Dry and siliceous ore.
9	Yuba Consolidated Gold Fields.	do	Yuba River	Dredging gravel.
10	Natomas Co.	do	Folsom	Do.
11	Nevada Consolidated Copper Corporation.	Nevada	Robinson	Copper ore.
12	Hammon Consolidated Gold Fields.	Alaska	Nome	Dredging gravel.
13	Mountain Copper Co.	California	Iron Mountain and Mother Lode.	Dry and siliceous ore.
14	Capital Dredging Co.	do	Folsom	Dredging gravel.
15	London Gold Mines Co.	Colorado	Mosquito	Dry and siliceous ore.
16	Lava Cap Gold Mining Corporation.	California	Grass Valley and Nevada City.	Do.
17	Golden Queen Mining Co.	do	Mojave	Do.
18	Kennedy Mining & Milling Co.	do	Mother Lode	Do.
19	The Argonaut Mining Co., Ltd.	do	do	Do.
20	United States Smelting, Refining & Mining Co.	Utah	West Mountain	Lead ore, lead-zinc ore, and siliceous ore.
21	Eureka Standard Consolidated Mining Co.	do	Tintic	Dry and siliceous ore.
22	Shenandoah-Dives Mining Co.	Colorado	Animas	Do.
23	Goldfield Consolidated Mining Co.	Nevada	Goldfield	Do.
24	Carson Hill Gold Mining Co.	California	Mother Lode	Do.
25	Snelling Gold Dredging Co.	do	Snelling	Dredging gravel.

[1] Custom mill. Includes mainly ore from Cresson, Portland, Ajax, and other mines in Cripple Creek district, Colorado, but also from other districts in Colorado.

In 1936 the 25 largest producers of gold were distributed as follows: 12 in California, 3 each in Alaska, Colorado, and Utah, 2 in Nevada, and 1 each in Arizona and South Dakota; of these companies 15 produced gold from dry and siliceous ores, 6 from gravel by floating dredges, 3 from copper ore, and 1 from combined lead ore, lead-zinc ore, and siliceous ore. In 1935 there were 11 in California, 4 in Alaska, 3 in Colorado, 2 in Utah, and 1 each in Arizona, Idaho, Nevada, New Mexico, and South Dakota; of these companies 14 produced gold from dry and siliceous ores, 6 from gravel by floating dredges, 3 from copper ore, 1 from lead-zinc ore, and 1 from combined lead ore, lead-zinc ore, and siliceous ore.

The Benguet Consolidated Mining Co. (including the Balatoc mine, controlled by Benguet stockholders) in the Philippine Islands ranked between the Homestake mine and the Golden Cycle Corporation as a gold producer in 1935; its output increased in 1935 from 1934 and has shown a large increase again in 1936.

LEADING SILVER PRODUCERS

The output of silver from the 25 leading producing companies in 1936, none of which produced less than 310,000 ounces, was 42,011,500 ounces, or 69 percent of the mine total (Philippine Islands and Puerto Rico excluded). Of these companies 7 were operating in Utah, 4 in Idaho, 3 each in Arizona, Montana, and Nevada, 2 in Colorado, and 1 each in California, New Mexico, and Texas; 8 of the companies recovered silver from dry and siliceous ore, 7 from zinc-lead ore, 4 from copper ore, 2 from lead ore, 1 from copper-lead-zinc ore, 2 from combined lead, lead-zinc, and siliceous ores, and 1 from combined copper, zinc-lead, and silver ores.

Larger producers of silver in the United States, 1935–36, in order of output

1935

Rank	Operator	State	Mining district	Source of silver
1	Anaconda Copper Mining Co.	Montana	Summit Valley (Butte).	Copper ore and lead-zinc ore.
2	Sunshine Mining Co	Idaho	Evolution	Dry siliceous ore.
3	Phelps Dodge Corporation (Copper Queen).	Arizona	Warren	Copper ore.
4	Empire Zinc Co	Colorado	Battle Mountain	Do.
5	United States Smelting, Refining & Mining Co.	Utah	West Mountain	Lead ore, lead-zinc ore, and siliceous ore.
6	Bunker Hill & Sullivan Mining & Concentrating Co.	Idaho	Yreka	Lead ore and lead-zinc ore.
7	Tintic Standard Mining Co	Utah	Tintic	Lead ore and siliceous ore.
8	Silver King Coalition Mines Co.	do	Uintah	Lead-zinc ore.
9	Federal Mining & Smelting Co. (Morning mine).	Idaho	Hunter	Do.
10	Hecla Mining Co	do	Lelande	Lead ore.
11	American Metal Co. (Presidio mine).	Texas	Shafter	Siliceous ore.
12	Treadwell Yukon Co., Ltd	Nevada	Tybo	Lead-zinc ore.
13	Park City Consolidated Mining Co.	Utah	Blue Ledge	Do.
14	Trout Mining Co	Montana	Flint Creek	Do.
15	Eagle-Picher Mining & Smelting Co.	Arizona	Ruby	Do.
16	Magma Copper Co	do	Pioneer	Copper ore and siliceous ore.
17	Utah Copper Co	Utah	West Mountain	Copper ore.
18	Combined Metals Reduction Co.	Nevada	Pioche	Lead-zinc ore.
19	Tonopah Mining Co	do	Tonopah	Dry and siliceous ore.
20	American Metal Co. (Pecos mine).	New Mexico	Willow Creek	Lead-zinc ore.
21	Base Metals Tunnel Co	Montana	Cataract	Do.
22	Black Hawk Consolidated Mines Co.	New Mexico	Central	Do.
23	Eureka Standard Consolidated Mines Co.	Utah	Tintic	Dry and siliceous ore.
24	United Verde Extension Mining Co.	Arizona	Verde	Copper ore.
25	Tombstone Development Co.	do	Tombstone	Siliceous ore and lead ore.

1936

Rank	Operator	State	Mining district	Source of silver
1	Sunshine Mining Co	Idaho	Evolution	Dry and siliceous ore.
2	Anaconda Copper Mining Co.	Montana	Summit Valley and Hog Heaven.	Copper ore, zinc-lead ore, and silver ore.
3	Phelps Dodge Corporation	Arizona	Warren and Verde	Copper ore.
4	Empire Zinc Co	Colorado	Battle Mountain	Do.
5	United States Smelting, Refining & Mining Co.	Utah	West Mountain	Lead ore, lead-zinc ore, and siliceous ore.
6	Bunker Hill & Sullivan Mining & Concentrating Co.	Idaho	Yreka	Do.
7	Tintic Standard Mining Co	Utah	Tintic	Lead ore.
8	Silver King Coalition Mining Co.	do	Uintah	Lead-zinc ore.
9	American Metal Co. (Presidio mine).	Texas	Shafter	Dry and siliceous ore.
10	Hecla Mining Co	Idaho	Lelande	Lead ore.
11	Utah Copper Co	Utah	West Mountain	Copper ore.
12	American Machine & Metal Co.	Montana	Summit Valley	Lead-zinc ore.
13	Federal Mining & Smelting Co.	Idaho	Hunter and Yreka	Do.
14	Magma Copper Co	Arizona	Pioneer	Copper ore.
15	Park City Consolidated Mines Co.	Utah	Uintah	Dry and siliceous ore.
16	Treadwell Yukon Co., Ltd	Nevada	Tybo	Lead-zinc ore.
17	Eagle-Picher Mining & Smelting Co.	Arizona	Oro Blanco	Do.
18	Butte Copper & Zinc Co	Montana	Summit Valley	Do.
19	Park Utah Consolidated Mines Co.	Utah	Uintah	Dry and siliceous ore.
20	Tonopah Mining Co	Nevada	Tonopah	Do.
21	Combined Metals Reduction Co.	do	Pioche	Zinc-lead ore.
22	Sierra Consolidated Mines, Inc.	California	Mount Patterson	Dry and siliceous ore.
23	Asarco Mining Co	New Mexico	Central	Copper-lead-zinc ore.
24	Eureka Standard Mining Co.	Utah	Tintic	Dry and siliceous ore.
25	G. A. Franz	Colorado	Uncompahgre	Do.

In 1935 the output from the 25 leading silver-producing companies was nearly 36,865,000 ounces, or 76 percent of the mine total (Philippine Islands and Puerto Rico excluded). Ten of these companies (4 in Idaho, 3 in Utah, and 1 each in Arizona, Colorado, and Montana) produced more than 1,000,000 ounces each, and none yielded less than 218,000 ounces; 6 were in Utah, 5 in Arizona, 4 in Idaho, 3 each in Montana and Nevada, 2 in New Mexico, and 1 each in Colorado and Texas. Only four of these large producers derived all their silver from dry and siliceous ores; the great bulk of the silver came from base ores, mainly lead-zinc and copper ores.

NUMBER OF MINES

The following table indicates the number of mines that produced gold and silver in 1935. The placers are those in which the gold and the silver in natural alloy with the gold and, in a few placers, with platinum are recovered from gravel and sand, whether by hand washing, sluicing, hydraulicking, drifting (in frozen ground or ancient buried river channels), or dredging. The lode mines are those yielding gold and silver (from ore as distinguished from gravel) mainly from underground workings, including those that yield ore valuable chiefly for copper, lead, or zinc but that contribute precious metals as byproducts. In addition to producing mines enumerated here many properties were being prospected and developed, and many other mining claims were being held by assessment work only.

The enumeration of placer mines is less satisfactory than that of lode mines, because some are operated only temporarily and are individually small and because much of the production is made by transitory miners not regularly working placer ground. So far as possible the unit, as for lode mines, is not the operator but the mining claim or group of claims.

Number of mines in the United States producing gold and silver in 1935, by States [1]

State	Lode	Placer	Total	State	Lode	Placer	Total
Alabama	3	2	5	New York [3]	1		1
Alaska [2]	69	639	708	North Carolina	15	17	32
Arizona	904	1,197	2,101	Oregon	115	268	383
California	1,487	1,112	2,599	Pennsylvania	1		1
Colorado	870	842	1,712	South Carolina	8	12	20
Georgia	6	30	36	South Dakota	15	199	214
Idaho	289	1,079	1,368	Tennessee [3]	3		3
Illinois [3]	1		1	Texas	14		14
Michigan [3]	2		2	Utah	204	31	235
Missouri [3]	1		1	Virginia [3]	2	2	4
Montana	681	551	1,232	Washington	63	172	235
Nevada	706	149	855	Wyoming	38	10	48
New Mexico	150	234	384		5,648	6,546	12,194

[1] Philippine Islands and Puerto Rico excluded.
[2] Estimate.
[3] Number of mines contributing to production of gold and silver.

Number of mines in the United States producing gold and silver, 1931–35 [1]

Year	Lode	Placer	Total	Year	Lode	Placer	Total
1931	1,988	2,081	4,069	1934	4,655	7,444	12,099
1932	2,871	3,496	6,367	1935	5,648	6,546	12,194
1933	3,283	3,742	7,025	Average	3,689	4,662	8,351

[1] Philippine Islands and Puerto Rico excluded.

MINE PRODUCTION

SUMMARY

The following tables give (1) the mine production of gold and (2) the mine production of silver in 1935 and 1936, by States, as reported to the Bureau of Mines by the producing mines.

Mine production of gold in the United States, 1935–36, by regions and States, in terms of recovered metal

Region and State	Fine ounces		Increase or decrease		Value (at $35 per ounce)	
	1935	1936	Fine ounces	Percent	1935	1936
Western States and Alaska:						
Alaska	469, 495. 00	[1] 539, 162. 60	+69, 667. 60	+15	$16, 432, 325	[1] $18, 870, 691
Arizona	241, 754. 60	[1] 310, 000. 00	+68, 245. 40	+28	8, 461, 411	[1] 10, 850, 000
California	890, 430. 00	1, 077, 442. 00	+187, 012. 00	+21	31, 165, 050	37, 710, 470
Colorado	349, 280. 80	366, 607. 00	+17, 326. 20	+5	12, 224, 828	12, 831, 245
Idaho	83, 823. 06	80, 291. 40	−3, 531. 66	−4	2, 933, 807	2, 810, 199
Montana	151, 088. 03	[1] 181, 100. 00	+30, 011. 97	+20	5, 288, 081	[1] 6, 338, 500
Nevada	188, 031. 00	[1] 284, 700. 00	+96, 669. 00	+51	6, 581, 085	[1] 9, 964, 500
New Mexico	33, 435. 00	33, 037. 00	−398. 00	−1	1, 170, 225	1, 156, 295
Oregon	54, 160. 11	60, 753. 00	+6, 592. 89	+12	1, 895, 604	2, 126, 355
South Dakota	567, 230. 20	586, 353. 40	+19, 123. 20	+3	19, 853, 057	20, 522, 369
Texas	518. 00	613. 00	+95. 00	+18	18, 130	21, 455
Utah	184, 759. 80	223, 444. 00	+38, 684. 20	+21	6, 466, 593	7, 820, 540
Washington	9, 739. 60	12, 217. 40	+2, 477. 80	+25	340, 886	427, 609
Wyoming	3, 715. 00	1, 964. 40	−1, 750. 60	−47	130, 025	68, 754
	3, 227, 460. 20	3, 757, 685. 20	+530, 225. 00	+16	112, 961, 107	131, 518, 982
Eastern States:						
Alabama	2, 227. 24	4, 726. 00	+2, 498. 76	+112	77, 953	165, 410
Georgia	993. 78	449. 57	−544. 21	−55	34, 782	15, 735
Maryland		668. 00	+668. 00			23, 380
North Carolina	2, 175. 57	2, 037. 17	−138. 40	−6	76, 145	71, 301
Pennsylvania	745. 00	890. 00	+145. 00	+19	26, 075	31, 150
South Carolina	2, 273. 51	287. 39	−1, 986. 12	−87	79, 573	10, 059
Tennessee	423. 00	410. 00	−13. 00	−3	14, 805	14, 350
Virginia	652. 56	908. 97	+256. 41	+39	22, 840	31, 814
	9, 490. 66	10, 377. 10	+886. 44	+9	332, 173	363, 199
Philippine Islands	451, 818. 00	[2] 599, 657. 00	+147, 839. 00	+33	15, 813, 630	[2] 20, 987, 995
Puerto Rico	63. 00	482. 00	+419. 00	+665	2, 205	16, 870
	451, 881. 00	600, 139. 00	+148, 258. 00	+33	15, 815, 835	21, 004, 865
	3, 688, 831. 86	4, 368, 201. 30	+679, 369. 44	+18	129, 109, 115	152, 887, 046

[1] Subject to revision. [2] Refinery receipts.

Mine production of silver in the United States, 1935–36, by regions and States, in terms of recovered metal

Region and State	Fine ounces		Increase or decrease		Value	
	1935	1936	Fine ounces	Per-cent	1935 (at $0.71875 per ounce)	1936 (at $0.7745 per ounce)
Western States and Alaska:						
Alaska	286,848	427,592	+140,744	+49	$206,172	$331,170
Arizona	6,601,280	[1] 8,125,100	+1,523,820	+23	4,744,670	[1] 6,292,890
California	1,191,112	2,103,799	+912,687	+77	856,112	1,629,392
Colorado	4,696,064	5,902,776	+1,206,712	+26	3,375,296	4,571,700
Idaho	10,240,953	14,537,530	+4,296,577	+42	7,360,685	11,259,317
Montana	9,322,951	[1] 11,585,600	+2,262,649	+24	6,700,871	[1] 8,973,047
Nevada	4,393,426	[1] 4,970,000	+576,574	+13	3,157,775	[1] 3,849,265
New Mexico	1,061,902	1,163,255	+101,353	+10	763,242	900,941
Oregon	110,385	85,061	−25,324	−23	79,339	65,880
South Dakota	151,047	144,448	−6,599	−4	108,565	111,875
Texas	1,000,960	1,361,459	+360,499	+36	719,440	1,054,450
Utah	9,206,329	9,997,645	+791,316	+9	6,617,049	7,743,176
Washington	52,338	66,900	+14,562	+28	37,618	51,814
Wyoming	1,152	1,113	−39	−3	828	862
	48,316,747	60,472,278	+12,155,531	+25	34,727,662	46,835,779
Eastern States:						
Alabama	401	869	+468	+117	288	673
Georgia	74	28	−46	−62	53	22
Maryland		33	+33			26
New York	21,750	18,251	−3,499	−16	15,633	14,135
North Carolina	7,584	5,575	−2,009	−26	5,451	4,318
Pennsylvania	5,843	8,118	+2,275	+39	4,200	6,287
South Carolina	1,117	50	−1,067	−96	803	39
Tennessee	47,151	50,330	+3,179	+7	33,890	38,981
Virginia	55	96	+41	+75	40	74
	83,975	83,350	−625	−1	60,358	64,555
Central States:						
Illinois	3,147	1,780	−1,367	−43	2,262	1,379
Michigan	4,219		−4,219	−100	3,032	
Missouri	110,551	163,720	+53,169	+48	79,459	126,801
	117,917	165,500	+47,583	+40	84,753	128,180
Philippine Islands	[2] 322,022	[2] 467,885	+145,863	+45	231,453	[2] 362,377
Puerto Rico	8	[1] 187	+179	+2,238	6	[1] 145
	322,030	468,072	+146,042	+45	231,459	362,522
	48,840,669	61,189,200	+12,348,531	+25	35,104,232	47,391,036

[1] Subject to revision. [2] Refinery receipts.

Gold and silver produced in the Western States of the United States and in Alaska, 1848–1935, in terms of recovered metals

[Compiled by Chas. W. Henderson]

State	Period	Gold		Silver (fine ounces)
		Fine ounces	Value [1]	
Western States:				
Arizona	1860–1935	8, 287, 492	$177, 557, 368	221, 002, 811
California	1848–1935	92, 399, 883	1, 936, 099, 522	88, 336, 217
Colorado	1858–1935	36, 079, 558	756, 661, 494	672, 346, 106
Idaho	1863–1935	6, 950, 535	146, 408, 114	365, 008, 965
Montana	1862–1935	15, 311, 494	320, 355, 495	649, 550, 746
Nevada	1859–1935	22, 799, 456	476, 542, 636	551, 095, 128
New Mexico	1848–1935	1, 930, 755	40, 910, 618	57, 502, 661
Oregon	1852–1935	5, 122, 305	107, 243, 718	4, 242, 992
South Dakota	1876–1935	16, 469, 364	358, 024, 935	8, 386, 026
Texas	1885–1935	5, 485	125, 920	24, 629, 507
Utah	1865–1935	7, 321, 651	156, 482, 797	614, 424, 216
Washington	1860–1935	1, 502, 292	31, 335, 494	9, 439, 480
Wyoming	1867–1935	71, 551	1, 612, 634	72, 653
Total, Western States		214, 251, 821	4, 509, 360, 745	3, 266, 037, 508
Alaska	1880–1935	21, 190, 355	454, 677, 148	17, 944, 930
Grand total		235, 442, 176	4, 964, 037, 893	3, 283, 982, 438

[1] Gold valued per fine ounce as follows: Prior to 1933, $20.67+; 1933, $25.56; 1934, $34.95; 1935, $35.

ORE PRODUCTION, CLASSIFICATION, METAL YIELD, AND METHODS OF RECOVERY

The best index of lode mining is the quantity and metallic content of ore mined rather than the number of mines or operators. The following tables give details of classes of ore, metal yield in fine ounces of gold and silver to the ton, and gold and silver output by classes of ore and by methods of recovery, embracing all ores that produced gold and silver in the United States (excluding the Philippine Islands and Puerto Rico) in 1935. The individual State chapters from which these tables were compiled contain additional tables and text on the subject and may be found elsewhere in this volume.

The classification originally adopted in 1905 on the basis of smelter terminology and recovery has been used continuously in succeeding years, except for modifications necessitated by the improvement in recovery of metals and the lowering of grade of complex ores treated, accomplished by improved mill concentration processes. A "dry" ore is one that carries so little lead or copper that by itself in quantity it would not satisfy the requirements for the smelter charge in lead smelting or copper smelting, respectively. The copper ores include those smelting ores that contain 2.5 percent dry assay or more of copper (or less than this percentage if no other metal is present), or those ores concentrated chiefly for their copper content. The lead ores are those that contain 5 percent dry assay [should be 7.5 to 8.5 percent—C. W. H.] or more of lead, irrespective of precious-metal content; an ore that carries any grade of lead exclusively is called a lead ore. Zinc smelting ores (chiefly oxides) range from 16 to 45 percent zinc; zinc concentrating ores include any grade of zinc ore that makes marketable zinc concentrate, irrespective of precious-metal content. The mixed ores are combinations of those enumerated. In the tables that follow, figures for dry and siliceous ores have not been separated into gold, gold-silver, and silver ores. Siliceous

(silica [3] in excess of iron) gold, gold-silver, and silver ores containing too little copper, lead, or zinc to be classified as copper, lead, zinc, or mixed ores are called "dry" ores regardless of the ratio of concentration, except low-grade ore milled chiefly for its copper content and having very little or no precious-metal content and ores from which separate products of lead concentrates and zinc concentrates are made. The crude ore into the mill in these two exceptional instances thus takes its name from its products—a name that is also justified by the mineralogical content and final recovery of metals. The "dry and siliceous ores" thus, by elimination, include both dry siliceous and irony, but chiefly siliceous, ores valuable for their gold and silver content, regardless of method of treatment, and dry fluxing ores carrying considerable quantities of iron and manganese oxides, or iron sulphide, and very small quantities of gold and silver. The smelter classification applies to concentrates.

The lead, zinc, and lead-zinc ores in most districts in the Eastern and Central States carry no appreciable quantity of gold or silver; such ores are excluded from this report.

[3] Except where mineralization approaches a matte, ores in their natural state generally contain more silica than iron and usually are highly siliceous.

Ore produced in the United States and average recovery in fine ounces of gold and silver per ton, 1931–35 [1]

State	Dry and siliceous ore			Copper ore			Lead ore			Zinc ore			Copper-lead and copper-lead zinc ores			Lead-zinc ore			Total ore (short tons)
	Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton		
		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver		Gold	Silver	
Alaska	3,833,338	0.047	0.03	44,655		3.27	22	0.463	41.86										3,878,015
Arizona	604,644	.186	1.85	6,011,755	0.019	.76	16,749	.197	13.79	7,126	0.023	5.42	4	0.120	18.25	129,772	0.062	5.16	6,770,050
California	3,237,926	.167	.33	94,577	.028	.50	1,471	.250	19.68	379		.44	120	.876	19.23	3,300	.010	4.69	3,337,773
Colorado	1,535,534	.205	1.09	209,492	.041	13.31	16,419	.363	9.41				295	.304	22.20	9,244	.090	7.39	1,770,984
Idaho	443,951	.113	14.58	243	.102	29.58	256,077	.002	5.47							820,674	.002	2.86	1,520,945
Montana	554,853	.202	3.02	1,259,892	.002	3.45	9,085	.121	8.96	[2] 123,441		.11	308	.012	4.75	464,534	.019	6.90	2,412,113
Nevada	1,263,751	.114	2.00	2,904,641	.011	.04	29,494	.073	9.95				135	.044	15.81	194,798	.015	7.44	4,392,819
New Mexico	79,696	.180	4.23	3,275	.147	4.11	403	.266	8.39				277	.017	22.44	357,058	.042	1.96	440,709
Oregon	184,543	.116	.58																184,543
South Dakota	1,487,205	.381	.10				30	.103	50.63										1,487,235
Texas	71,892	.007	13.90				274	.090	5.61				56	.004	2.34				72,222
Utah	635,171	.140	4.97	6,530,569	.010	.09	78,332	.122	13.11				11	.036	33.27	527,513	.035	8.41	7,771,596
Washington	31,145	.262	1.41	752	.042	4.63	287	.031	16.53							3	.097	25.33	32,187
Wyoming	4,172	.242	.15										18	.011	10.17				4,190
Eastern States	48,275	.154	.05	[3] 1,715,459	.001	.04				([4])						[5] 228,448		.09	1,992,182
1935: Total	14,016,096	.154	1.39	18,775,310	.012	.68	408,643	.057	8.19	130,946	.001	.40	1,224	.172	15.87	2,735,344	.020	4.72	36,067,563
Percentage	38.86			52.06			1.13			0.36						7.59			100.00
1934: Total	11,852,890	.156	.72	11,575,092	.013	.67	368,421	.046	8.53	133,130		.05	120,562	.003	30.95	2,099,573	.019	4.54	26,149,668
Percentage	45.33			44.26			1.41			0.51			0.46			8.03			100.00
1933: Total	8,680,376	.180	.42	8,363,586	.013	.70	717,649	.019	5.47	122,594	.002	.58	126,207	.001	27.49	1,182,311	.036	5.20	19,192,723
1932: Total	8,226,167	.197	.48	11,504,946	.009	.45	697,168	.023	7.02	41,410		.07	167,106		20.18	815,177	.062	6.49	21,451,974
1931: Total	8,329,009	.177	.52	30,966,550	.009	.31	894,636	.020	6.84	97,950		.06	213,245	.006	13.09	1,484,530	.045	4.69	41,985,920

[1] Illinois, Missouri, Philippine Islands, and Puerto Rico excluded; quantity of crude ore containing gold and silver unknown.
[2] Current slag fumed.
[3] Includes pyritiferous magnetite ore from Pennsylvania yielding 8,709 tons of copper concentrates.
[4] Zinc ore yielded no gold or silver.
[5] Figures represent New York and Tennessee lead-zinc ores. Lead-zinc ore from Virginia yielded no gold or silver.

Mine production of gold in the United States in 1935, by States, in fine ounces [1]

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Copper-lead ore	Lead-zinc ore	Total
Alabama	5.09	2,222.15						2,227.24
Alaska	290,002.95	179,465.94	15.93	10.18				469,495.00
Arizona	5,157.00	112,266.75	112,783.79	3,295.23	162.71	0.48	8,088.64	241,754.60
California	345,526.00	541,774.62	2,622.82	367.97	.49	105.12	32.98	890,430.00
Colorado	19,363.00	314,510.22	8,529.28	5,960.83		89.70	827.77	349,280.80
Georgia	332.50	661.28						993.78
Idaho	31,751.03	50,141.19	24.77	574.78			1,331.29	83,823.06
Montana	26,299.23	112,023.30	2,704.24	1,101.25		3.86	8,956.15	151,088.03
Nevada	7,880.00	144,414.72	30,527.75	2,144.26		5.98	3,058.29	188,031.00
New Mexico	3,554.40	14,358.63	481.80	107.01		4.70	14,928.46	33,435.00
North Carolina	90.84	1,904.73	180.00					2,175.57
Oregon	32,704.03	21,456.08						54,160.11
Pennsylvania [2]			745.00					745.00
South Carolina	143.00	2,130.51						2,273.51
South Dakota	936.86	566,290.24		3.10				567,230.20
Tennessee			423.00					423.00
Texas		493.00		24.80		.20		518.00
Utah	255.80	88,819.53	67,689.79	9,523.21		.40	18,471.07	184,759.80
Virginia	153.82	498.74						652.56
Washington	1,547.60	8,151.24	31.57	8.90			.29	9,739.60
Wyoming	2,705.20	1,009.60				.20		3,715.00
1935: Total	768,408.35	2,162,592.47	226,759.74	23,121.52	163.20	210.64	55,694.94	3,236,950.86
Percentage	23.74	66.81	7.01	0.71		0.01	1.72	100.00
1934: Total	721,380.02	1,853,894.65	145,930.28	16,956.55		328.98	40,297.13	2,778,787.61
Percentage	25.96	66.72	5.25	0.61		0.01	1.45	100.00

[1] Philippine Islands and Puerto Rico excluded. The Bureau of Science, Manila, P. I., reports that bullion from lode mines (all siliceous ore) of the Philippine Islands in 1935 yielded 449,437 ounces of gold and placer mines 2,381 ounces.
[2] From pyritiferous magnetite ore.

Gold produced in the United States, 1922–35, by percent from sources, as reported by mines, and in total fine ounces [1]

Year	Percent from—							Total fine ounces
	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Copper-lead and copper-lead-zinc ores	Lead-zinc ore	
1922	23.46	68.06	5.71	1.54	0.12	0.11	1.00	2,293,251
1923	22.95	62.79	11.30	1.58	.14	.16	1.08	2,404,918
1924	18.44	65.56	12.70	1.63	.01	.08	1.58	2,444,331
1925	18.91	61.30	15.08	2.18	.02	.24	2.27	2,307,374
1926	20.50	58.03	16.36	2.05	.05	.15	2.86	2,232,526
1927	21.42	55.17	17.45	1.97	.07	.12	3.80	2,107,032
1928	19.41	55.67	19.31	1.67	.01	.32	3.61	2,148,064
1929	19.83	52.17	22.24	1.81	.06	.19	3.70	2,058,993
1930	20.59	59.27	15.57	1.24	.02	.15	3.16	2,188,724
1931	20.36	66.16	9.65	.79		.05	2.99	2,224,729
1932	23.37	69.53	4.24	.68			2.18	2,330,020
1933	25.17	67.77	4.59	.59	.01	.01	1.86	2,303,709
1934	25.96	66.72	5.25	.61		.01	1.45	2,778,788
1935	23.74	66.81	7.01	.71		.01	1.72	3,236,951

[1] Philippine Islands and Puerto Rico excluded.

Gold produced in the United States, 1922–35, by sources, as reported by mines, in fine ounces [1]

Year	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Copper-lead and copper-lead-zinc ores	Lead-zinc ore	Total
1922–31	4,603,990	13,555,182	3,214,286	368,499	11,315	35,100	571,565	22,359,937
1932	544,433	1,620,102	98,914	15,788		48	50,735	2,330,020
1933	579,909	1,561,256	105,838	13,508	254	111	42,833	2,303,709
1934	721,380	1,853,895	145,930	16,957		329	40,297	2,778,788
1935	768,408	2,162,592	226,760	23,122	163	211	55,695	3,236,951

[1] Philippine Islands and Puerto Rico excluded.

Siliceous ore treated and gold recovered per ton of ore treated in 4 Western States, 1931–36

Year	Alaska		California		South Dakota		Colorado	
	Ore treated	Recovery per ton	Ore treated	Recovery per ton	Ore treated	Recovery per ton	Ore treated	Recovery per ton
	Short tons	*Ounce*	*Short tons*	*Ounce*	*Short tons*	*Ounce*	*Short tons*	*Ounce*
1931	4,195,000	0.054	1,008,411	0.310	1,404,153	0.308	811,619	0.281
1932	4,068,000	.056	978,218	.343	1,409,893	.340	885,087	.353
1933	4,171,000	.053	1,281,843	.274	1,432,555	.357	741,900	.309
1934	4,390,000	.046	2,299,699	.193	1,520,669	.319	1,164,575	.259
1935	3,833,338	.047	3,237,926	.167	1,487,205	.381	1,535,534	.205
1936	4,455,979	.043	4,179,341	.160	1,549,146	.379	1,861,431	.180

Mine production of silver in the United States in 1935, by States, in fine ounces [1]

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Copper-lead ore	Lead-zinc ore	Total
Alabama		401						401
Alaska	39,479	100,313	146,135	921				286,848
Arizona	832	1,115,594	4,545,944	230,971	38,629	73	669,237	6,601,280
California	23,902	1,072,385	47,935	28,955	167	2,307	15,461	1,191,112
Colorado	3,968	1,673,522	2,789,222	154,468		6,550	68,334	4,696,064
Georgia	10	64						74
Idaho	12,185	6,473,899	7,189	1,400,889			2,346,791	10,240,953
Illinois [2]				3,147				3,147
Michigan			[3] 4,219					4,219
Missouri				110,551				110,551
Montana	3,495	1,674,286	4,350,353	81,384	13,127	1,464	3,198,842	9,322,951
Nevada	2,609	2,523,438	121,908	293,567		2,134	1,449,770	4,393,426
New Mexico	302	337,075	13,444	3,383		6,215	701,483	1,061,902
New York							21,750	21,750
North Carolina	6	618	6,960					7,584
Oregon	3,975	106,410						110,385
Pennsylvania [4]			5,843					5,843
South Carolina	8	1,109						1,117
South Dakota	103	149,425		1,519				151,047
Tennessee			47,097				54	47,151
Texas		999,292		1,537		131		1,000,960
Utah	32	3,154,792	602,852	1,029,525		366	4,418,762	9,206,329
Virginia	3	52						55
Washington	263	43,774	3,481	4,744			76	52,338
Wyoming	352	617				183		1,152
1935: Total	91,524	19,427,066	12,692,582	3,345,561	51,923	19,423	12,890,560	48,518,639
Percentage	0.19	40.04	26.15	6.90	0.11	0.04	26.57	100.00
1934: Total	96,045	8,523,969	7,748,876	3,142,098	6,944	3,730,917	9,533,455	32,782,304
Percentage	0.29	26.00	23.64	9.59	0.02	11.38	29.08	100.00

[1] Philippine Islands and Puerto Rico excluded. The Bureau of Science, Manila, P. I., reports that bullion from gold lode mines of the Philippine Islands in 1935 yielded 321,833 ounces of silver and placer mines 196 ounces.
[2] From fluorspar-lead ores.
[3] Native silver in lumps recovered at copper mine but not from copper bullion.
[4] From pyritiferous magnetite ore.

Silver produced in the United States, 1922–35, by percent from sources, as reported by mines, and in total fine ounces [1]

Year	Percent from—							Total fine ounces
	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Copper-lead and copper-lead-zinc ores	Lead-zinc ore	
1922	0.10	46.78	16.95	27.38	2.74	1.09	4.96	61,207,989
1923	.08	39.28	20.87	28.62	3.09	1.92	6.14	70,355,674
1924	.08	31.82	25.50	29.43	.04	1.86	11.27	64,070,744
1925	.08	25.63	27.06	28.15	.27	1.45	17.36	66,710,080
1926	.08	21.71	27.27	24.85	.50	2.27	23.32	62,487,219
1927	.08	19.75	24.41	26.44	2.83	3.64	22.85	59,625,682
1928	.08	19.25	25.46	23.18	.20	3.82	28.01	57,872,443
1929	.07	18.25	29.49	19.23	2.59	4.66	25.71	60,860,011
1930	.09	18.32	28.53	18.40	.94	6.39	27.33	47,724,903
1931	.16	14.63	32.07	20.48	.02	9.35	23.29	29,856,628
1932	.28	17.29	22.78	21.53	.01	14.83	23.28	22,739,669
1933	.28	15.62	25.23	16.96	.31	15.00	26.60	23,130,596
1934	.29	26.00	23.64	9.59	.02	11.38	29.08	32,782,304
1935	.19	40.04	26.15	6.90	.11	.04	26.57	48,518,639

[1] Philippine Islands and Puerto Rico excluded.

Silver produced in the United States, 1922–35, by sources, as reported by mines, in fine ounces [1]

Year	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Copper-lead and copper-lead-zinc ores	Lead-zinc ore	Total
1922–30	456,006	150,087,876	137,344,207	139,718,882	8,197,583	15,865,734	99,244,457	550,914,745
1931	46,521	4,369,200	9,573,651	6,114,975	6,023	2,791,101	6,955,157	29,856,628
1932	63,844	3,931,144	5,180,776	4,894,938	3,025	3,371,570	5,294,372	22,739,669
1933	64,661	3,613,276	5,836,091	3,922,183	70,723	3,470,054	6,153,608	23,130,596
1934	96,045	8,523,969	7,748,876	3,142,098	6,944	3,730,917	9,533,455	32,782,304
1935	91,524	19,427,066	12,692,582	3,345,561	51,923	19,423	12,890,560	48,518,639

[1] Philippine Islands and Puerto Rico excluded.

Gold and silver produced in the United States from ore, old tailings, etc., in 1935, by States and by methods of recovery [1]

State	Total quantity of crude ore, old tailings, etc., treated (short tons)	Ore, old tailings, etc., to gold and silver mills				Ore and old tailings to concentrating mills (short tons)	Concentrates from all sources			Crude ore to smelters			Ore leached,[2] old tailings and slag smelted, etc.		
		Ore (short tons)	Old tailings, etc. (short tons)	Gold (fine ounces)	Silver (fine ounces)		Short tons	Gold (fine ounces)	Silver (fine ounces)	Short tons	Gold (fine ounces)	Silver (fine ounces)	Short tons	Gold (fine ounces)	Silver (fine ounces)
Alaska	3,878,015	3,827,099	----------	159,155	26,750	43,000	9,694	19,185	134,094	7,916	1,152	86,525	--------	--------	--------
Arizona	6,770,050	223,060	48,850	49,816	103,817	4,815,612	320,334	76,485	1,989,712	1,350,679	109,955	4,501,586	331,849	342	5,333
California	3,337,773	2,074,278	782,361	376,820	384,560	452,470	44,047	146,998	542,672	23,599	20,570	239,416	5,065	516	562
Colorado	1,770,984	1,055,646	----------	176,462	77,300	443,024	51,859	115,609	909,100	272,314	37,847	3,705,696	--------	--------	--------
Idaho	1,520,945	160,381	23,620	24,054	16,787	1,315,585	201,785	23,416	9,541,223	21,160	4,489	666,997	199	113	3,761
Montana	2,412,113	231,859	1,001	39,272	64,540	1,924,826	453,999	38,017	7,785,298	123,285	45,738	1,409,050	131,142	1,762	60,568
Nevada	4,392,819	223,555	614,191	70,493	431,823	3,376,649	175,925	55,248	2,075,647	171,054	53,544	1,826,880	7,370	866	56,467
New Mexico	440,799	55,355	----------	7,272	199,679	370,004	73,402	17,415	778,905	15,440	5,193	83,016	--------	--------	--------
Oregon	184,543	14,141	2,127	3,976	916	167,123	5,843	15,487	96,996	1,129	1,960	8,332	23	33	166
South Dakota	1,487,235	1,487,205	----------	566,207	149,416	----------	5	83	9	30	3	1,519	--------	--------	--------
Texas	72,222	70,166	----------	308	672,260	805	914	179	310,356	1,251	31	18,344	--------	--------	--------
Utah	7,772,017	40,595	185,293	16,006	4,666	7,058,044	406,221	84,878	5,003,328	486,634	82,036	4,180,949	1,471	1,584	17,354
Washington	32,187	13,302	----------	2,167	1,745	3,586	325	106	13,444	15,296	5,919	36,810	3	--------	76
Wyoming	4,190	4,027	----------	313	106	----------	40	186	15	163	511	679	--------	--------	--------
Eastern States	1,992,182	19,987	----------	1,523	298	1,871,362	42,116	4,576	69,614	100,833	2,667	14,036	--------	--------	--------
	36,068,074	9,500,656	1,657,443	1,493,844	2,134,663	21,842,090	1,786,509	597,868	29,250,413	2,590,783	371,615	16,779,835	477,122	5,216	144,287
Total, 1934	26,148,868	9,065,985	1,029,306	1,294,023	1,322,270	14,233,109	1,203,581	458,132	19,453,026	1,685,828	294,538	11,757,966	134,640	10,656	89,092

[1] Illinois, Michigan, Missouri, Philippine Islands, and Puerto Rico excluded.

[2] No ore leached in 1934.

Gold and silver produced at mills in the United States and percentage of gold and silver recovered by smelting and from placers, 1931–35 [1]

Year	Ore treated (short tons)	Bullion recovered from all sources (fine ounces)				Percent of gold and silver from all sources							
		Amalgamation		Cyanidation		Amalgamation		Cyanidation		Placers		Smelting [2]	
		Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1931	7,623,878	806,317	274,850	396,390	1,254,866	36.2	0.9	17.8	4.2	20.4	0.2	25.6	94.7
1932	7,684,543	851,391	260,447	434,869	753,228	36.5	1.1	18.7	3.3	23.4	.3	21.4	95.3
1933	7,853,875	893,678	377,823	352,136	227,262	38.8	1.6	15.3	1.0	25.2	.3	20.7	97.1
1934	10,096,091	866,336	250,209	503,482	1,193,450	31.2	.8	18.1	3.6	26.0	.3	24.7	95.3
1935	11,026,921	928,948	433,446	565,767	1,701,275	28.7	.9	17.5	3.5	23.7	.2	30.1	95.4

[1] Philippine Islands and Puerto Rico excluded. [2] Both crude ores and concentrates.

Gold and silver bullion produced at mills in the United States in 1935, by States [1]

State	Ore (short tons)	Bullion recovered from all sources (fine ounces)				Percent of gold and silver from all sources in State			
		Amalgamation		Cyanidation		Amalgamation		Cyanidation	
		Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Alaska	3,827 099	159,155	26,750			33.90	9.33		
Arizona	271,910	3,678	1,223	46,138	102,594	1.52	.02	19.08	1.55
California	2,856,639	287,184	167,374	89,636	217,186	32.25	14.05	10.07	18.23
Colorado	1,055,646	53,611	21,082	122,851	56,218	15.35	.45	35.17	1.20
Idaho	184,001	21,687	15,290	2,368	1,497	25.87	.15	2.82	.01
Montana	232,860	16,395	36,574	22,877	27,966	10.85	.39	15.14	.30
Nevada	837,746	42,189	84,906	28,304	346,917	22.44	1.93	15.05	7.90
New Mexico	55,355	846	170	7,238	199,567	2.53	.01	21.65	18.80
Oregon	16,268	3,850	866	126	50	7.11	.79	.23	.05
South Dakota	1,487,205	335,554	75,858	230,653	73,558	59.16	50.22	40.66	48.70
Texas	70,166			367	672,260			70.85	67.16
Utah	225,888	1,118	2,100	14,888	2,566	.60	.02	8.05	.03
Washington	13,302	1,846	849	321	896	18.95	1.62	3.30	1.71
Wyoming	4,027	312	106			8.40	9.20		
Eastern States	19,987	1,523	298			16.05	.15		
Total: 1935	11,158,099	928,948	433,446	565,767	1,701,275	28.70	.89	17.45	3.50
1934	10,096,091	866,336	250,209	503,482	1,193,450	31.2	.8	18.1	3.6
1933	7,853,875	893,678	377,823	352,136	227,262	38.8	1.6	15.3	1.0
1932	7,684,543	851,391	260,447	434,869	753,228	36.5	1.1	18.7	3.3
1931	7,623,878	806,317	274,850	396,390	1,254,866	36.2	.9	17.8	4.2

[1] Philippine Islands and Puerto Rico excluded.

PLACERS

Dredging.—Placer gold is obtained chiefly from gravel handled by connected-bucket floating dredges, which recovered 66 percent of the total output from placers in the United States (Philippine Islands and Puerto Rico excluded) in 1936 and 67.11 percent in 1935. The quantity of gold recovered by dredges from the inception of the industry as a commercial factor in 1896 to the end of 1935 is recorded as 13,855,909 ounces, originating by States as follows: California, 9,076,624 ounces; Alaska, 3,151,495 ounces; Montana, 494,909 ounces; Colorado, 415,922 ounces; Idaho, 376,767 ounces; Oregon, 305,791 ounces; and other States, 34,401 ounces. The output in 1936 was 605,307 ounces from 103 dredges, of which California produced 285,691 ounces from 45 dredges; Alaska, 255,803 ounces from 38 dredges; Idaho, 26,098 ounces from 12 dredges; Montana, 19,120 ounces from 2 dredges; Oregon, 17,067 ounces from 5 dredges; and Colorado, 1,528 ounces from 1 dredge.

Connected-bucket floating gold dredges operated in the United States, 1935–36, by companies

ALASKA

Company	Address	District	Number of dredges 1935	Number of dredges 1936
Gold Placers, Inc.	Fairbanks	Circle		1
Council Dredging Co.	Council	Council	1	1
North Star Dredging Co.	do.	do.	1	1
Ophir Gold Dredging Co.	do.	do.	1	1
Straub & Kimball	do.	do.	1	1
Fairbanks Exploration Co.	Fairbanks	Fairbanks	5	5
Fish Creek Mining Co.	do.	do.	1	
J. R. Murphy, lessee from Fairbanks Gold Dredging Co., Ltd.	Meehan	do.	2	1
Arctic Circle Explorations, Inc. (formerly Keewalik Mining Co.).	Candle	Fairhaven	1	1
Forsgren Dredging Co.	Deering	do.	1	1
Alaska Gold Dredging Corporation	Dawson	Fortymile		1
Jack Wade Dredging Co.	Jack Wade	do.		1
Walker's Fork Gold Corporation	Steel Creek	do.	1	1
American Creek Operating Co.	Fairbanks	Hot Springs	1	1
North American Dredging Co.	Flat	Iditarod	1	1
J. E. Riley Investment Co.	do.	do.	1	1
Felder & Gale	Takotna	Innoko	1	1
Ganes Creek Dredging Co.	Ophir	do.	1	1
W. F. Puntila	Takotna	do.	2	2
Fox Bar Dredging Co.	Nome	Kougarok	1	1
Wallace Porter	Haycock	Koyuk	1	1
Dry Creek Dredging Co.	Nome	Nome	1	1
Greenstone Mines, Inc.	do.	do.	1	1
Hammon Consolidated Gold Fields	do.	do.	3	3
Alaska Sunset Mines Corporation	do.	do.	1	1
Bartholomae Oil Corporation	Teller	Port Clarence	1	1
N. B. Tweet & Son	do.	do.	1	1
Casa de Paga Gold Co.	Solomon	Solomon	1	1
Spruce Creek Dredging Co.	Nome	do.	1	1
New York Alaska Gold Dredging Co.	Bethel	Tuluksak-Aniak	2	3
			36	38

CALIFORNIA

Company	Address	District	Number of dredges 1935	Number of dredges 1936
Camanche Placers, Ltd.	Camanche	Camanche	1	1
Comanche Gold Dredging Co.	do.	do.	1	1
Wallace Dredging Co.	San Francisco	do.		1
Consumnes Gold Dredging Co.	do.	Consumnes River		1
Charles Staheli	Cottonwood	Cottonwood Creek	1	1
Gold Hill Dredging Co.	San Francisco	Folsom	2	1
Natomas Co.	Sacramento	do.	6	6
Capital Dredging Co.	San Francisco	do.	3	3
Sacramento Gold Dredging Co.	Folsom	do.		1
George G. Dawson	Smartville	French Corral		1
Oro Bell Dredging Co.	Sacramento	Gold Run	1	1
Pioneer Dredging Co.	Redding	Igo		2
Junction City Mining Co.	San Francisco	Junction City		1
Geo. A. Hawkes	Modesto	Knights Ferry		1
La Grange Gold Dredging Co.	San Francisco	La Grange	1	1
Lancha Plana Gold Dredging Co.	Camanche	Lancha Plana	1	1
Trinity Dredging Co.	Lewiston	Lewiston	1	1
Antelope Creek Dredging Co.	San Francisco	Loomis		1
Gold Hill Dredging Co.	do.	do.		1
Arroyo Seco Gold Dredging Co.	do.	Mother Lode	1	2
Canyon Creek Dredge	do.	do.	1	
C. W. Neilsen	San Andreas	do.		1
A. E. Clark	Folsom	do.		1
Gold Bar Dredging Co.	Lewiston	New River	1	1
Cal-Oro Dredging Co.	San Francisco	North Central	1	1
Oroville Gold Dredging Co.	Oroville	Oroville	1	1
Laurence Neal	do.	do.	1	
Yuba Consolidated Gold Fields	San Francisco	do.	1	1
Palermo Dredging Co.	do.	do.	1	
Yuba Consolidated Gold Fields	do.	Snelling	2	2
Snelling Gold Dredging Co.	Snelling	do.	2	2
Merced Dredging Co.	San Francisco	do.	1	1
Yuba Consolidated Gold Fields	do.	Yuba River	5	5
			36	45

Connected-bucket floating gold dredges operated in the United States, 1935-36, by companies—Continued

COLORADO

Company	Address	District	Number of dredges 1935	Number of dredges 1936
Continental Dredging Co	Breckenridge	Breckenridge	1	1
Tiger Placers Co	Tiger	do	1	
			2	1

IDAHO

Company	Address	District	1935	1936
Baumhoff-Fisher Co	Centerville	Boise Basin	1	2
The Grimes Co	Boise	do	1	1
Moores Creek Dredging Co	do	do		1
Jordan Creek Placers	do	Carson	1	1
Mount Vernon Mining Co	Elk City	Elk City	1	1
Little Smoky Dredging Co	Boise	Little Smoky	1	1
Gold Creek Placer Co	Pierce	Pierce		1
Gold Dredging, Inc	do	do	1	1
Baumhoff-Fisher Co	Warren	Warren		1
Idaho Gold Dredging Co	do	do	2	2
Warren Creek Dredging Co	do	do	1	
			9	12

MONTANA

Company	Address	District	1935	1936
Porter Bros	Helena	Helena	1	1
Yuba Consolidated Gold Fields	San Francisco	Ophir	1	
Pioneer Placer Dredging Co	Goldcreek	Pioneer	1	1
			3	2

OREGON

Company	Address	District	1935	1936
Monarch Gold Dredging Co	Prairie City	Canyon	1	1
Rogue River Gold Co	Rogue River	Gold Hill and Greenback.[1]	1	1
Pioneer Gold Dredging Co	Baker	Mormon Basin	1	1
Sumpter Valley Dredging Co	Sumpter	Sumpter	1	1
Timms Gold Dredging Co	Portland	Susanville	1	1
			5	5

[1] Dredge operated part of 1935 in Gold Hill district, Jackson County; moved later in 1935 to Greenback district, Josephine County.

Gold produced in the United States by dredges, 1931-36, in fine ounces

Year	Dredges	California	Alaska	Other States [1]	Total
1931	58	175,086	181,358	10,837	367,281
1932	57	188,831	207,674	17,181	413,686
1933	63	201,710	200,563	29,248	431,521
1934	74	194,051	269,082	49,940	513,073
1935	91	238,043	216,560	61,065	515,668
1936	103	285,691	255,803	63,813	605,307

[1] Arizona, Colorado, Idaho, Montana, and Oregon.

Other placer-mining methods.—From 1932 through 1936 dragline and power-shovel excavators operated in connection with dry-land and floating amalgamating and sluicing plants have been widely used in placer mining. In 1936, 16 percent of the total output of placer gold was recovered at these plants, and 18 percent was produced by old established mining methods such as hydraulicking, drift mining, sluicing, and rocking.

Additional information on placer-mining methods may be found in the State reviews in Minerals Yearbook and Mineral Resources.

PRODUCTION IN PHILIPPINE ISLANDS

The value [4] of the gold produced in the Philippine Islands from 1907 to 1935, inclusive, is recorded as $77,128,126. The value [4] of the output during the last 10 years was as follows:

1927	$1, 686, 231	1932	$5, 050, 084
1928	1, 904, 062	1933	8, 308, 009
1929	3, 320, 300	1934	11, 893, 975
1930	3, 704, 800	1935	15, 813, 630
1931	3, 762, 433	1936	[1] 20, 987, 995

[1] Refinery receipts.

The output was considerably larger in 1936 than it was in 1935, as several new mills were in operation. Among the larger producing mines are: Benguet Consolidated, Balatoc, Itogen, Antamok, Demonstration, Baguio, Suyoc, Penique, Benguet Exploration, Ipo, United Paracle, I X L, Masbate Consolidated Atok, and Salacot. The milling capacity of many of the mines was increased in 1936 and some new mills were built.

The gold dredges operated in the Philippine Islands in 1935 were those of the Tambis Gold Dredging Co. and the Coco Grove, Inc. Their recovery was comparatively small in 1935, but they were being operated on a much larger scale in 1936, so that their output of gold will show a large increase.

[4] Gold valued per fine ounce as follows: Prior to 1933, $20.67+; 1934, $34.95; 1935 and 1936, $35.

COPPER

By J. W. Furness and H. M. Meyer

SUMMARY OUTLINE

The salient features of the copper industry in 1936 include the increase in apparent world consumption, the influence of the London market upon price in the United States, the substantial reduction in domestic and world stocks, and the apparent shift in the burden of financing stocks.

Except in 1929, world requirements of copper in 1936 were the highest on record, approximating 112 percent of the annual average for 1925–29. The domination of foreign price over that in the United States in the last quarter of 1936 marked one of the major changes in the economics of the copper industry. From September on, despite a tariff of 4 cents a pound on metal imported into the United States, the price of copper was higher in the international market than in New York. There was considerable lag between the rapid price advances in the international market and price changes in the domestic trade. Another important factor was the notable decrease in world stocks of refined copper, which were 353,000 tons on December 31 (132,000 tons less than at the end of 1935) and probably not much more than half the record inventories on hand at the end of 1932. Basic statistics for stocks of copper held by manufacturers or in the hands of speculators are not available. The abnormally large sales of copper for advance future delivery at extended periods indicate that the burden of financing stocks has shifted in part from the producer to the consumer and speculator.

For many years the United States consumed more copper than continental Europe, but in 1931 this condition was reversed. The peak of consumption in the United States was reached in 1929, whereas Europe attained it in 1936.

Apparent consumption of copper in the United States in 1936 was 656,179 tons, 49 percent larger than in 1935 and 84 percent of the

annual average for 1925–29. Largely because of the incomplete nature of data on stocks, the figures of apparent consumption for any year do not represent the actual tonnage of copper that may have entered into consumptive channels. (See table, p. 155.) They are useful, however, in indicating trends.

Salient statistics of the copper industry in the United States, 1925–29 (average) and 1933–36, in short tons

	Average, 1925–29	1933	1934	1935	1936
New copper produced—					
From domestic ores, as reported by—					
Mines	885,826	190,643	237,405	380,491	[1] 600,711
Ore produced:					
Copper ore	59,505,871	[2] 8,387,612	[2] 11,723,638	[2] 19,112,030	(3)
Average yield of copper, percent	1.44	2.11	1.92	1.89	(3)
Smelters	892,730	225,000	244,227	381,294	611,410
Percent of world total	51	20	17	23	31
Refineries	890,767	240,669	233,029	338,321	645,462
From foreign ores, matte, etc., refinery reports	317,287	130,120	212,331	250,484	177,027
Total new refined, domestic and foreign	1,208,054	370,789	445,360	588,805	822,489
Secondary copper recovered from old scrap only	347,512	260,300	310,900	361,700	382,700
Copper content of copper sulphate produced by refiners	4,601	3,240	3,167	3,376	4,642
Total production, new and old and domestic and foreign	1,560,167	634,329	759,427	953,881	1,209,831
Imports (unmanufactured)	391,212	143,717	[4] 213,286	[4] 257,182	[4] 190,339
Refined	59,236	5,432	[4] 27,417	[4] 18,071	[4] 4,782
Exports of metallic copper [5]	522,616	151,913	296,359	295,198	259,032
Refined (ingots, bars, rods, etc.)	482,868	132,371	272,138	275,006	236,091
Stocks at end of year	307,200	600,500	479,000	411,000	305,500
Refined copper	86,100	406,500	284,500	175,000	110,000
Blister and materials in solution	221,100	194,000	194,500	236,000	195,500
Withdrawals from total supply on domestic account:					
Total new copper	778,123	339,350	322,638	441,371	656,179
Total new and old copper	1,288,700	677,500	700,000	890,000	1,141,000
Price, average ... cents per pound	14.7	6.4	8.0	8.3	9.2
World smelter production, new copper	1,761,000	1,143,000	1,448,000	1,684,000	[6] 1,984,000

[1] Subject to revision.
[2] Includes old tailings.
[3] Figures not yet available.
[4] Data for 1934–36 include copper imported for immediate consumption plus material entering the country under bond as do figures for earlier years.
[5] Total exports of copper, exclusive of ore, concentrates, composition metal, and unrefined copper. Exclusive also of "Other manufactures of copper" for which figures of quantity are not recorded.
[6] Approximate.

Efforts to control price.—The price of copper advanced abruptly in the last quarter of the year after holding within narrow limits during months of record-breaking sales. In April, July, and October, successive new high-record sales for a single month were made in the domestic market. Notwithstanding these record sales, the average monthly price for electrolytic copper, f. o. b. refinery, was only 9.563 cents a pound in October compared with 9.025 cents in January. In consequence of the continued heavy purchases of copper in November and December, following the already heavy drain on supplies, the price moved up to 11.775 cents a pound on the last day of the year. This vigorous upswing continued at an accelerated rate until the price reached 16.775 cents on March 31, 1937. Producers in the United States and abroad increased their rates of production greatly in the latter part of 1936 in an apparent attempt to maintain a conservative price policy, in order to encourage a continuation of the increasing rate of consumption and to discourage substitution and the opening up of marginal mines. The record sales and sharply rising prices

were brought about largely by greater industrial demand from abroad, increased demands for armaments because of disturbed political conditions in some of the large industrial countries of the world, threatened devaluation of currencies, and, chiefly as a result of the foregoing, increased speculation on the London Metal Exchange. The division of domestic bookings for December 1936, published in the American Metal Market, showing a large quantity for far-forward delivery, is in part an indication of the speculative nature of sales in that month:

Delivery	*Short tons*
December	2,951
January	855
February	1,080
March	71,162
April and beyond	41,667
	117,715

The efforts of producers outside of the United States in 1935 and the first part of 1936 to bring output into line with consumptive requirements lowered inventories and probably contributed to the tenseness of conditions late in 1936 and early in 1937. (In April 1936 the restriction agreement was extended to July 1, 1938, as announced in Minerals Yearbook, 1936, p. 109). At the end of 1936, foreign producers who were parties to the production-control agreement were operating at 105 percent of their quota basis compared with 70 percent prior to August 1. Early in January 1937 all restrictions on production were removed. That this action failed to dampen the enthusiasm of consumers and speculators for the metal is attested by continued large sales resulting in the increase in price, already mentioned, to 16.775 cents a pound in March 1937.

Historical résumé.—A brief résumé of the history of the copper industry during the last 16 years is given below to clarify, in part, some of the conditions mentioned that affected the domestic copper industry at the close of the year and to indicate the trends that became dominant factors in the last quarter of 1936.

Due to a large excess of production over consumption, the majority of the copper mines in the United States closed down in 1921. At the end of the first quarter of that year the refined stocks of copper in hands of producers in the United States and Chile were 366,099 short tons. To relieve the situation, a Copper Exporters Association was formed, and this corporation arranged for the financing of 200,000 tons of copper, to be marketed only in the export trade. Partly as a result of these measures and partly because of the rapid recovery of industry from the depression of 1921, stocks were reduced to 98,845 tons by the end of the second quarter of 1923. In the latter part of 1924, however, it became evident that production once more exceeded consumption and that stocks again were accumulating. On October 12, 1926, the Copper Exporters, Inc., an association of American copper producers, and certain foreign producers and sellers of copper, was organized under the provisions of the Webb-Pomerene Act. The association represented, broadly, the control of approximately 90 percent of the world copper production. The purpose of the organization was to endeavor to "eliminate in foreign countries the harmful speculation that causes wide fluctuations in price, unwarranted by industrial factors in European markets, and tends to destroy

confidence in the integrity of such price and the stability of business."

On December 31, 1926, the stocks of refined copper in North and South America totaled 85,501 short tons. The average quoted price of electrolytic copper f. o. b. refinery for the year was 13.795 cents a pound. At the close of December 1927 stocks were 95,298 tons, and the average price for the year was 12.920 cents a pound. At the close of December 1929 stocks of refined copper were 171,320 tons, and the average price for the year was 18.107 cents a pound. On December 31, 1929, stocks of blister and refined copper in North and South American amounted to 439,726 tons. During the month of January 1929 the high price of electrolytic copper was 16.775 cents a pound. In March it reached a maximum of 23.775 cents and in April receded to 17.775 cents, where it remained until the following April. The effect of this price was to accelerate the development of copper mines throughout the world, particularly in South Africa and Canada. In 1930 the British Empire became self-sufficient as to its copper requirements and for the first time since 1880 had an exportable surplus. Increased production from the newly developed districts, combined with the falling off in demand due to world-wide depression as well as the accumulations of stocks and the steady supply of secondary copper, reduced the world price to a low of 5 cents in December 1932. Drastic curtailment was inaugurated, but the latent capacity for production, from a world standpoint, was almost one-third greater than the peak of world consumption. Between 1929 and 1936 the relation of the leading copper-producing countries to world production changed appreciably. The following table shows changes in proportions of the world total supplied by the leading countries. The effect of the curtailment agreement on the alinement in 1936 is apparent.

	1929 (percent)	*1935 (percent)*	*1936 (percent)*
United States	48	23	31
Chile	16	17	14
Rhodesia	0. 3	10	8
Canada	4	11	10
Belgian Congo	7	7	?

During the period 1922–29, when the United States supplied more than 70 percent of the world demand from domestic mines and those controlled in foreign countries, the domestic copper producers could inaugurate policies that were world-wide in their effect, and through the Copper Exporters, Inc., controlled both exports and world price. One of the first acts of this association was to abolish the speculative control of price that had been exercised for many years by the London Metal Exchange, and for the first time in the history of domestic production world price was established in New York; this condition was made possible largely by the circumstances outlined above, indicating that the British Empire could not satisfy its copper requirements and had to purchase the major part of its needs from the United States. As the mines of South Africa and Canada came into production and, with the Belgian holdings, proved capable of supplying the larger part of the needs of the industrial nations outside of the United States, the London Metal Exchange was again able to function, and in the latter part of 1936 it became evident that the price of copper was being established once more in London and not in New York.

During the latter half of 1936 the domestic producers on five different occasions felt that it was necessary to meet the advance in foreign price. At the same time, owing to the high price for copper, many marginal mines in the United States that had been closed by the depression were reopened. The low-cost copper producers inaugurated the policy of full production to build up producers' stocks and attempt to overcome the uneconomic distribution of available copper. The present trends differ so slightly from what has gone before it seems probable that in the near future the history of the industry will not deviate materially from that of the past.

United States and world reserves.—According to an estimate by Ira B. Joralemon, W. W. Lynch, and C. K. Leith in connection with Arizona tax legislation in 1935 (quoted in Minerals Yearbook, 1936), a total of 17,602,000 tons of metallic copper was minable at equipped properties in the United States at a cost below 10 cents a pound, and an additional 4,210,000 tons at above 10 cents, with some 4,310,000 tons more minable in unequipped properties, where the cost of mining was uncertain.

Barbour's [1] estimate of copper-metal reserves for the United States was 30,000,000 to 35,000,000 tons of metal, of which 20,000,000 were officially reported. His estimate for the world was:

Country	Short tons	Country	Short tons
United States	20, 992, 700	Belgian Congo	6, 511, 000
Canada	5, 620, 200	Russia	10, 851, 000
Chile	35, 498, 500	All other	2, 961, 400
Rhodesia	22, 395, 400		104, 830, 200

Effects of price on consumption.—The major use for copper is in the electrical trades, and no substitute has been found that meets to the same efficient degree the chemical and physical requirements demanded by this industry. During the period of high prices, however, many of the transmission lines built throughout the United States were made of aluminum. At price, aluminum pig and that of copper are commercially interchangeable. Notwithstanding the drop in the price of copper, aluminum has held its own in this phase of the industry.

In the building trades, for other than electrical household equipment, the use of copper by the architect or building contractor is a matter of cost. According to the Copper and Brass Research Association, the indications were that although less than half as much money was expended in building in 1936 as in 1929, the consumption of brass pipe and copper tubing in 1936 was estimated to have exceeded the consumption in any previous year by 15,000,000 pounds. The same authority stated that there was a substantial increase in the use of copper for roofs and flashings, gutters and downspouts in 1936, that 10,000,000 pounds more copper were consumed by manufacturers of mechanical refrigeration than in any other 12-month period, that 20,000,000 feet of copper tubing were used by manufacturers of oil burners, more than in any previous year, and that the consumption of copper by the radio industry was of record proportions in 1936.

High prices for copper curtail its use in such materials as spandrels, down-takes and roofing, as well as in various forms of hardware when

[1] Barbour, Percy E., World Copper-Ore Reserves: Eng. and Min. Jour., vol. 135, no. 10, New York, October 1934, pp. 448–449.

copper, aluminum, rustless steel, lead, and zinc meet in a highly competitive market.

Wide fluctuations in price ultimately are reflected in the consumption of any metal, and copper is not an exception.

DOMESTIC PRODUCTION

Statistics on copper production may be compiled on a mine, smelter, or refinery basis. Mine data are most accurate for showing the geographical distribution of production; smelter figures are better for showing the actual recovery of metal and are fairly accurate for showing source of production; and refinery statistics give precise information regarding metal recovered but indicate in a general way only the source of crude materials treated. The chapter on Copper in Mineral Resources, 1930, contains a discussion of the differences among the three sets of figures.

Copper produced from domestic ores, as reported by mines, smelters, and refineries, 1932–36, in pounds

Year	Mine	Smelter	Refinery
1932	476,221,076	544,009,948	445,077,874
1933	381,285,194	449,999,143	481,338,031
1934	474,810,458	488,454,107	466,058,360
1935	760,995,826	762,587,340	676,642,866
1936	[1] 1,201,422,000	1,222,819,396	1,290,924,195

[1] Subject to revision.

PRIMARY COPPER

Smelter production.—The recovery of copper by United States smelters from ores of domestic origin amounted to 1,222,819,396 pounds in 1936, an increase of 60 percent over the total for 1935, which, in turn, was 56 percent larger than that in 1934. The 1936 production was 31 percent of the world smelter total and marked a notable improvement over 1935, when domestic smelter production was only 23 percent. During the period 1925–29, however, the United States produced 51 percent of the world smelter-copper output.

The figures for smelter production in 1936 are based on confidential returns from all smelters handling copper-bearing materials produced in the United States. For Michigan, the sum of furnace-refined copper and copper cast into anodes for electrolytic refining is included. The figures for blister represent the fine-copper content. Some casting and electrolytic copper produced direct from ore or matte is included in the smelter production. Metallic and cement copper recovered by leaching also is included in smelter production.

The precise quantity, in pounds, of copper produced by smelters in the United States and its value are shown by years for 1845–1930 in the Copper chapter of Mineral Resources of the United States, 1930. The data are summarized for comparison with those for 1931–36, in the following table.

Copper produced in the United States from domestic ores, 1932–36

[Smelter output, in pounds fine]

State	1932	1933	1934	1935	1936
Alabama			10, 972	10, 061	14, 293
Alaska	13, 297, 443	1, 575, 936	130, 284	14, 601, 603	30, 421, 557
Arizona	201, 136, 276	122, 697, 035	168, 408, 450	278, 519, 397	414, 144, 129
California	5, 514, 045	632, 049	232, 845	1, 629, 735	10, 327, 582
Colorado	8, 976, 169	8, 882, 397	13, 046, 759	14, 340, 744	19, 181, 339
Idaho	662, 957	2, 183, 284	1, 717, 895	2, 124, 725	2, 924, 763
Michigan	63, 898, 656	72, 340, 852	51, 681, 901	73, 811, 562	91, 105, 431
Missouri		181, 703	46, 276	85, 166	464, 418
Montana	97, 918, 141	94, 262, 651	67, 005, 217	157, 760, 435	215, 433, 377
Nevada	32, 616, 050	42, 507, 400	41, 922, 506	72, 818, 792	146, 154, 075
New Mexico	32, 914, 883	24, 948, 272	26, 994, 219	4, 559, 874	6, 974, 705
North Carolina	(1)	(1)	(1)	(1)	(1)
Oklahoma			10, 723		
Oregon	36, 890	9, 301	41, 422	372, 093	566, 388
Pennsylvania	(1)	(1)	(1)	(1)	(1)
South Carolina		408	421	7, 796	
Tennessee	(1)	(1)	(1)	(1)	(1)
Texas	8, 588	2, 137	32, 956	17, 995	55, 336
Utah	76, 402, 502	65, 655, 914	96, 223, 463	120, 972, 668	261, 202, 190
Virginia			384	683	
Washington	2, 521	87, 199	33, 393	81, 482	201, 944
Wyoming	607	46	3, 390	1, 749	42
Undistributed	10, 624, 220	14, 032, 559	20, 910, 631	20, 870, 780	23, 647, 827
	544, 009, 948	449, 999, 143	488, 454, 107	762, 587, 340	1, 222, 819, 396

[1] Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.

Copper produced (smelter output) in the United States, 1845–1936

[Values rounded]

Period	Quantity		Total value
	Total (short tons)	Average per year (short tons)	
1845-80	363, 996	10, 111	$175, 490, 000
1881-1900	2, 994, 764	149, 738	796, 355, 000
1901-10	4, 281, 716	428, 172	1, 273, 911, 000
1911-20	7, 160, 559	716, 056	2, 850, 306, 000
1921-30	7, 423, 403	742, 340	2, 117, 235, 000
1931	521, 356	521, 356	94, 887, 000
1932	272, 005	272, 005	34, 273, 000
1933	225, 000	225, 000	28, 800, 000
1934	244, 227	244, 227	39, 076, 000
1935	381, 294	381, 294	63, 295, 000
1936	611, 410	611, 410	112, 499, 000
1845-1936	24, 479, 730	266, 084	7, 586, 127, 000

Mine production.—The figures for mine production are based on reports furnished to the Bureau of Mines by all domestic mines that produce copper. Details of the method of collecting the statistics and reasons for the discrepancy between mine-, smelter-, and refinery-production figures are given in the Copper chapter of Mineral Resources of the United States, 1930.

Mine production is more accurate than either refinery or smelter production for showing the distribution of domestic production by States and districts. It also indicates the ore production by calendar years more exactly because additional time is required for smelting and refining. Mine production in 1936 was 1,201,422,000 pounds, an increase of 58 percent over that in 1935 but still 32 percent below the average for 1925–29.

Production by States and districts.—The following tables show mine and smelter production by States for 1935 and 1936 and by districts for 1930–36. In 1936 Arizona, Utah, Montana, Nevada, and Michigan led in production, with 92 percent of the smelter total, the same percentage as in 1935.

The five States that produced most of the output in 1936 also produced by far the greater part of the output for 1845–1936, with some change in the order of magnitude. Arizona had the largest total for 1845–1936, followed in order by Montana, Michigan, Utah, and Nevada, their total output amounting to 89 percent of that for the entire United States. It is interesting that Arizona produced a slightly higher percentage of the total in 1936 than in 1845–1936, 33.87 percent compared with 32.82 percent, that Montana's share dropped from 22.49 to 17.62 percent, and Michigan's from 18.06 to 7.45, while Utah's jumped from 10.90 to 21.36 and Nevada's from 4.53 to 11.95.

The principal copper-producing districts in the United States for 1845–1936 were, in the order named, Butte, Mont.; Lake Superior, Mich.; Bingham, Utah; and Bisbee, Ariz.

Details of production, by districts and companies, in 1936 are available in other chapters of this volume dealing with production of gold, silver, copper, lead, and zinc in the various States.

Copper produced in the United States, according to smelter and mine returns, by States, 1935–36, and 1845–1936, in short tons

	1935		1936			1845–1936, smelter output	
	Smelter returns	Mine returns	Smelter returns		Mine returns [1]	Total quantity	Percent of total
			Percent of total	Quantity			
Alabama	5	5		7	7	([2])	([2])
Alaska	7,301	7,750	2.49	15,211	[1] 14,583	638,618	2.61
Arizona	139,260	139,015	33.87	207,072	[1] 204,600	8,035,542	32.82
California	815	977	.84	5,164	[1] 4,381	553,513	2.26
Colorado	7,170	7,327	1.57	9,591	8,865	212,877	.87
Idaho	1,062	1,048	.24	1,462	1,477	76,726	.31
Michigan	36,906	32,054	7.45	45,553	47,984	4,420,172	18.06
Missouri	43	34	.04	232	191	([2])	([2])
Montana	78,880	77,479	17.62	107,717	[1] 109,552	5,504,762	22.49
Nevada	36,409	37,133	11.95	73,077	[1] 67,825	1,108,106	4.53
New Mexico	2,280	2,253	.57	3,487	3,166	775,186	3.17
North Carolina	([3])	([3])	([3])	([3])	([3])	([2])	([2])
Oregon	186	199	.05	283	287	10,823	.04
Pennsylvania	([3])	([3])	([3])	([3])	([3])	([2])	([2])
South Carolina	4	([4])				([2])	([2])
Tennessee	([3])	([3])	([3])	([3])	([3])	[5] 259,508	[5] 1.06
Texas	9	14		28	27	([2])	([2])
Utah	60,487	64,758	21.36	130,601	126,217	2,668,278	10.90
Virginia	([4])	([4])				([2])	([2])
Washington	41	43	.02	101	102	14,411	.06
Wyoming	1	1		([4])		15,863	.06
Undistributed	10,435	10,401	1.93	11,824	11,447	[6] 185,345	.76
	381,294	380,491	100.00	611,410	[1] 600,711	24,479,730	100.00

[1] Subject to revision.
[2] Included under "Undistributed." Figures not separately recorded.
[3] Included under "Undistributed." Bureau of Mines not at liberty to publish figures.
[4] Less than 1 ton.
[5] Approximate production through 1928. Figures for 1929–36 are confidential and are included under "Undistributed."
[6] Includes Tennessee for 1929–36.

Mine production of copper in the principal districts,[1] 1932–36, in terms of recovered copper, in short tons

District or region	State	1932	1933	1934	1935	1936
Butte	Montana	42,300	32,618	31,428	76,964	(2)
Bingham	Utah	31,234	35,818	41,793	63,060	124,453
Yavapai County (mostly Jerome district)	Arizona	17,904	16,629	13,199	38,086	(2)
Ely (Robinson)	Nevada	15,442	14,094	20,467	32,815	(2)
Bisbee (Warren)	Arizona	23,702	(3)	35,555	32,281	[4] 39,300
Lake Superior	Michigan	27,198	23,427	24,108	32,054	47,984
Globe-Miami	Arizona	14,224	129	7,161	18,680	[4] 54,575
Pioneer	do	11,026	10,915	16,367	15,874	[4] 15,075
Copper River	Alaska	[5] 4,369	(6)	(6)	[5] 7,750	(2)
Battle Mountain	Colorado	2,810	4,082	4,910	6,592	7,966
Central (including Santa Rita)	New Mexico	13,256	12,571	10,895	1,547	2,213
Coeur d'Alene region	Idaho	565	772	736	987	1,315
Ray (Mineral Creek)	Arizona	7,202	1,376	--------	1	(2)
Morenci-Metcalf	do	11,931	4	6	1	(2)
Ajo [7]	do	(3)	(3)	(3)	(3)	(2)
Swain County [7]	North Carolina	(3)	(3)	(3)	(3)	(3)
Lebanon (Cornwall mine)[7]	Pennsylvania	(3)	(3)	(3)	(3)	(3)
Ducktown [7]	Tennessee	(3)	(3)	(3)	(3)	(3)

[1] Districts producing 1,000 short tons or more in any year of the period, 1932–36.
[2] Data not yet available.
[3] Bureau of Mines not at liberty to publish figures.
[4] Subject to revision.
[5] Includes a small quantity produced elsewhere in State.
[6] Total for Alaska was 15 tons in 1933 and 57 tons in 1934.
[7] Not listed in order of output.

Quantity and estimated recoverable content of copper-bearing ores.—The following tables list the quantity and the estimated recoverable copper content of the ore produced by United States mines in 1935; figures for 1936 are not yet available. Of the total copper produced from copper ores in the United States in 1935, 75 percent was obtained from ores concentrated before smelting, 1 percent from ores leached, and 24 percent from direct-smelting ore. In 1934 the figures were 73 percent from concentrated ore and 27 percent from direct-smelting ore.

Close agreement between the output as reported by smelters and the recoverable quantity as reported by mines indicates that the estimated recoverable tenor is close to the actual recovery. Classification of some of the complex western ores is difficult and more or less arbitrary. Under copper ores are grouped not only those that contain 2.5 percent or more copper but also those that contain less than this percentage if they are valuable chiefly for copper. Under copper-lead and copper-lead-zinc ores are classed complex ores in which copper is a valuable constituent. Mines report considerable copper from ores mined primarily for other metals. These include siliceous gold and silver ores, lead and zinc ores, and pyritic sulphur ores.

The last table in the group, covering copper ores treated, indicates that producers respond to lower prices for metal by confining production to ores of higher grades. Copper prices began to fall sharply in 1930 and dropped from an annual quoted average of 18.11 cents a pound in 1929 to a low point of 5.56 cents in 1932. The average annual price increased steadily from 1932 until it reached 9.47 cents a pound in 1936. Conversely, the grade of ore improved with falling prices and dropped as prices rose. The average grade of ore treated for 1927–29 stood at 1.41 percent copper. The grade improved in each succeeding year through 1933, when the average reached 2.11 percent, the output of 1933 being under the influence of the record low price of December 1932. As prices improved and output increased, the grade fell to 1.92 percent in 1934 and 1.89 percent in 1935.

Figures for 1936 are not yet available, but the indications are that the grade of ore dropped further.

Copper ore, old tailings, etc., sold or treated in the United States in 1935, with copper, gold, and silver content in terms of recovered metals

State	Ore, old tailings, etc., sold or treated (short tons)	Copper produced		Gold produced (fine ounces)	Silver produced (fine ounces)	Value of gold and silver per ton of ore
		Pounds	Percent			
Alaska	44,655	15,222,664	17.04	15.93	146,135	2.55
Arizona	6,011,755	[1] 274,609,892	2.28	112,783.79	4,545,944	1.24
California	[2] 94,577	[1] 1,685,578	.89	2,622.82	47,935	1.36
Colorado	209,492	13,216,180	3.15	8,529.28	2,789,222	11.74
Idaho	243	33,020	6.79	24.77	7,189	26.48
Michigan	1,376,803	64,108,689	2.33		4,219	(3)
Montana	1,259,892	[1] 143,290,030	5.69	2,704.24	4,350,353	2.75
Nevada	2,904,641	73,682,748	1.27	30,527.75	121,908	.40
New Mexico	3,275	521,500	7.96	481.80	13,444	8.33
Utah	6,530,569	[1] 113,333,473	.87	67,689.79	602,852	.43
Washington	752	66,097	4.39	31.57	3,481	5.05
Eastern States	[4] 675,376	20,776,890	1.54	1,348.00	59,900	.14
	19,112,030	720,546,761	1.89	226,759.74	12,692,582	.93

[1] Excludes copper recovered from precipitates as follows: Arizona, 1,860,010 pounds; California, 1,303 pounds; Montana, 9,659,925 pounds; and Utah, 5,709,585 pounds.
[2] Includes a small quantity of pyrites roasted for the manufacture of sulphuric acid (residue leached).
[3] Not available.
[4] Includes copper concentrates from pyritiferous magnetite ore from Pennsylvania.

Copper ore, old tailings, etc., concentrated in the United States in 1935, with content in terms of recovered copper

State	Ore, old tailings, etc., concentrated (short tons)	Concentrates produced (short tons)	Copper produced (pounds)	Percent of copper from ore, etc.
Alaska	37,000	6,787	6,347,868	8.58
Arizona	4,425,682	288,020	131,553,887	1.49
California	(1)	(1)	(1)	(1)
Idaho	14	7	794	2.84
Michigan	1,376,803	47,755	64,108,689	2.33
Montana	1,239,285	314,509	140,923,589	5.69
Nevada	2,887,520	119,264	65,549,722	1.14
Utah	6,529,800	178,238	113,270,673	.87
Washington	650	77	38,080	2.93
Eastern States	[2] 568,665	38,364	14,784,210	[3] 1.28
	[4] 17,065,419	[4] 993,021	[4] 536,577,512	[4] 1.57

[1] Bureau of Mines not at liberty to publish figures.
[2] Pyritiferous magnetite ore yielding copper concentrates not included with copper ore.
[3] Obtained by using copper concentrates for Pennsylvania and copper ore for other Eastern States.
[4] Exclusive of relatively small quantities from California.

Copper ore, old tailings, etc., leached and smelted in the United States in 1935, with content in terms of recovered copper

State	Ore leached			Ore, old tailings, etc., smelted		
	Short tons	Copper produced (pounds)	Percent of copper	Short tons	Copper produced (pounds)	Percent of copper
Alaska				7, 655	8, 874, 796	57. 97
Arizona	331, 202	7, 516, 625	1. 13	1, 254, 871	135, 539, 380	5. 40
California	(1)	(1)	(1)	53	6, 630	62. 55
Colorado				209, 492	13, 216, 180	3. 15
Idaho				229	32, 226	7. 04
Montana				20, 607	2, 366, 441	5. 74
Nevada				17, 121	8, 133, 026	23. 75
New Mexico				3, 275	521, 500	7. 96
Utah				769	62, 800	4. 08
Washington				102	28, 017	13. 73
Eastern States				98, 002	5, 992, 680	3. 06
	331, 202	7, 516, 625	1. 13	1, 612, 176	174, 773, 676	5. 42

[1] Residue from pyrites roasted for the manufacture of sulphuric acid was leached, and a quantity of copper was recovered, but the Bureau of Mines is not at liberty to publish figures.

Copper-lead ores sold or treated in the United States in 1935, with content in terms of recovered copper

State	Copper-lead ores (short tons)	Copper produced (pounds)	Percent of copper
Arizona	4	686	8. 58
California	120	3, 471	1. 45
Colorado	295	23, 750	4. 03
Montana	[1] 308	4, 062	. 66
Nevada	135	2, 621	. 97
New Mexico	277	20, 250	3. 66
Texas	56	5, 450	4. 87
Utah	11	1, 012	4. 60
Wyoming	18	1, 000	2. 78
	1, 224	62, 302	2. 55

[1] Includes 250 tons of old tailings concentrated.

Ores, old tailings, etc., classed as copper-bearing (copper and copper-lead) sold or treated in the United States in 1935, with copper content, and copper produced from all sources, in terms of recovered copper

State	Copper from copper and copper-lead ores, old tailings, etc.			Copper from all sources, including old slags, smelter cleanings, and precipitates (pounds)
	Ores, old tailings, etc., sold or treated (short tons)	Copper produced (pounds)	Percent of copper	
Alaska	44,655	15,222,664	17.04	15,500,000
Arizona	6,011,759	274,610,578	2.28	278,029,289
California	94,697	1,689,049	.89	1,954,000
Colorado	209,787	13,239,930	3.16	14,654,000
Idaho	243	33,020	6.79	2,095,867
Michigan	1,376,803	64,108,689	2.33	64,108,689
Missouri				67,660
Montana [1]	1,260,200	143,294,092	5.69	154,957,470
Nevada	2,904,776	73,685,369	1.27	74,266,000
New Mexico [2]	3,552	541,750	7.63	4,505,000
Oregon				397,800
Texas	56	5,450	4.87	28,000
Utah [3]	6,530,580	113,334,485	.87	129,515,217
Washington	752	66,097	4.39	86,699
Wyoming	18	1,000	2.78	1,000
Eastern States	[4] 675,376	20,776,890	1.54	20,813,111
	19,113,254	720,609,063	1.89	760,979,802

[1] Considerable copper was recovered from precipitates.
[2] Considerable copper was derived from ores classed as lead-zinc ores.
[3] Considerable copper was derived from precipitates and from ores classed as gold ores and as lead-zinc ores.
[4] Includes copper concentrates from pyritiferous magnetite ores from Pennsylvania.

Copper ores produced in the United States, 1926–35, and average yield in copper, gold, and silver

Year	Smelting ores		Concentrating ores		Total				
	Short tons	Yield in copper (percent)	Short tons	Yield in copper (percent)	Short tons	Yield in copper (percent)	Yield per ton in gold (ounce)	Yield per ton in silver (ounce)	Value per ton in gold and silver
1926	3,767,947	4.75	52,083,784	1.24	57,181,894	1.46	0.0064	0.293	$0.31
1927	3,407,610	4.67	49,179,035	1.23	56,725,460	1.41	.0065	.255	.28
1928	3,766,368	4.44	54,214,485	1.24	62,097,132	1.41	.0067	.236	.28
1929	4,235,192	4.60	[1] 59,727,536	1.22	[1] 68,421,853	1.41	.0067	.262	.28
1930	2,983,912	4.57	[1] 41,327,237	1.23	[1] 47,381,509	1.43	.0070	.287	.26
1931	1,519,915	5.38	[1] 30,056,857	1.33	[1] 34,050,961	1.50	.0063	.281	.21
1932	758,623	6.98	[1] 10,964,749	1.51	[1] 12,320,194	1.83	.0080	.421	.28
1933	872,033	6.30	[1] 7,475,988	1.63	[1] 8,387,612	2.11	.0126	.696	.57
1934	977,096	6.21	[1] 10,681,967	1.53	[1] 11,723,638	1.92	.0124	.661	.86
1935	[1] 1,612,176	5.42	[2] 17,065,419	1.57	[1] 19,112,030	1.89	.0119	.664	.93

[1] Includes old tailings, etc.
[2] Includes old tailings, etc. Exclusive of small quantities from California which the Bureau of Mines is not at liberty to publish.

REFINERY PRODUCTION

The refinery output of copper in the United States in 1936 was made by 10 plants; 8 of these employed the electrolytic method, and 2 employed the furnace process on Lake Superior copper.

There are five large electrolytic refineries on the Atlantic seaboard, three lake refineries on the Great Lakes, and four refineries west of the Great Lakes—one at Great Falls, Mont.; one at Tacoma, Wash.; one at El Paso, Tex.; and one at Clifton, Ariz. Of the above plants,

the lake refinery of the Quincy Mining Co. and the plant of the Phelps Dodge Corporation that produces furnace-refined copper at Clifton, Ariz., have been idle since 1933.

In addition to the plants mentioned above, plants at Ajo and Inspiration, Ariz., are equipped to make electrolytically refined copper direct from the liquors obtained from leaching operations; this copper is shipped as cathodes to other refineries, where it is melted and cast into merchant shapes. The Inspiration plant was idle during 1933 and 1934, but operations were resumed during the latter part of 1935. The Ajo plant has been idle since 1931.

The above 14 plants constitute what is commonly referred to as "regular refineries." Of these plants, 10 employ the electrolytic process and 4 the furnace process. The electrolytic plants, excluding the Ajo unit which is no longer active, have a rated capacity of 1,612,000 tons of refined copper per annum. As they produced only 908,694 tons in 1936, only 56 percent of the electrolytic refining capacity was utilized. At the end of the year, however, they were producing at a considerably higher rate than that indicated for the year as a whole.

Refined copper is marketed in various grades, such as casting copper, lake copper, and electrolytic copper, and in various forms, such as wire bars, cathodes, and cakes. The differences in these various grades were explained on page 739 of the Copper chapter of Mineral Resources, 1930. The following tables show the production of refined copper at regular refining plants, classified according to source, grade, and form in which it was cast.

Primary and secondary copper produced by regular refining plants in the United States and imported, 1932–36, in pounds

	1932	1933	1934	1935	1936
Primary:					
Domestic:[1]					
Electrolytic	[2] 373,492,550	[2] 421,318,802	414,020,483	[2] 602,826,051	1,198,132,177
Lake	[2] 53,815,281	[2] 59,497,370	51,681,901	[2] 73,605,212	91,105,431
Casting	17,770,043	521,859	355,976	211,603	1,686,587
	445,077,874	481,338,031	466,058,360	676,642,866	1,290,924,195
Foreign:[1]					
Electrolytic	235,240,651	260,048,594	424,523,995	500,878,984	353,817,802
Casting and best select	549,209	191,927	137,510	88,947	235,413
Refinery production, new copper	680,867,734	741,578,552	890,719,865	1,177,610,797	1,644,977,410
Imports refined copper	167,793,988	10,863,358	[3] 54,833,436	[3] 36,142,671	[3] 9,563,232
Total new refined copper made available	848,661,722	752,441,910	945,553,301	1,213,753,468	1,654,540,642
Secondary:					
Electrolytic	120,397,873	170,878,078	243,189,320	296,028,315	265,437,556
Casting	56,654	160,214	720,514	927,450	392,167
	120,454,527	171,038,292	243,909,834	296,955,765	265,829,723
Grand total	969,116,249	923,480,202	1,189,463,135	1,510,709,233	1,920,370,365

[1] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation at this stage of manufacture is not possible.
[2] Some copper from Michigan was electrolytically refined at an eastern refinery and is included as electrolytic copper.
[3] Data for 1934–36 include copper imported for immediate consumption plus material entering the country under bond as do figures for earlier years.

Copper cast in different forms in the United States in 1935–36

Form	1935		1936	
	Pounds	Percent	Pounds	Percent
Wire bars	642,000,000	43.53	983,000,000	51.44
Cathodes	374,000,000	25.36	329,000,000	17.22
Cakes	261,000,000	17.69	342,000,000	17.89
Ingots	71,000,000	4.81	112,000,000	5.86
Other forms	127,000,000	8.61	145,000,000	7.59
	1,475,000,000	100.00	1,911,000,000	100.00

Besides the regular refineries, numerous plants throughout the country operate on scrap exclusively, producing metallic copper and a great variety of alloys. The output of these plants is not included in the statements of refined-copper production in the preceding tables but is included in the following statement of secondary-copper production.

Copper sulphate.—The production of hydrous copper sulphate or bluestone by copper refineries in the United States was 36,444,550 pounds having a copper content of 9,283,000 pounds in 1936 compared with 26,507,526 pounds having a copper content of 6,752,000 pounds in 1935.

The output of copper sulphate by plants other than the regular primary refineries was 33,962,947 pounds with a reported copper content of 8,626,000 pounds in 1936 compared with 35,887,265 pounds containing 9,136,000 pounds of copper in 1935.

The increase in production at regular primary refineries more than offset the drop at other plants.

SECONDARY COPPER

Secondary copper includes material recovered from remelting old copper and copper scrap and from the treatment of copper alloys or alloys treated without separation of the copper. The following table summarizes the production of secondary copper during the past 5 years. Further details appear in the chapter on Secondary Metals.

Secondary copper produced in the United States, 1932–36, in short tons

	1932	1933	1934	1935	1936
Copper as metal	140,500	193,100	220,400	270,000	260,000
Copper in alloys	107,680	145,000	157,000	178,900	224,600
Total secondary copper	248,180	338,100	377,400	448,900	484,600
From new scrap	67,200	77,800	66,500	87,200	101,900
From old scrap	180,980	260,300	310,900	361,700	382,700
Percent of domestic mine output	104	177	159	118	81

The production of secondary copper in 1936 increased only 8 percent, whereas the output of copper by the mines was 58 percent larger. In consequence, the ratio of secondary to primary production fell from 118 percent in 1935 to 81 in 1936, a continuation of the decline from 177 percent in 1933, when the rate of activity at domestic copper mines was at an extremely low level. It is reasonable to assume that

the ratio will decline further in the near future, although the long-time trend indicates that secondary copper is supplying a steadily increasing proportion of our total copper output. In 1910 secondary copper was equivalent to less than 20 percent of the domestic mine output, whereas in 1929 it was 63 percent.

CONSUMPTION AND USES

New supply.—The total available supply of new copper consists of the total output of primary copper by refineries plus the imports of refined copper; in 1936 it amounted to 1,654,540,642 pounds, an increase of 36 percent over 1935. (See table on p. 153). If this figure is reduced by the quantity of refined copper exported and adjusted for changes in stocks at refineries, the quantity of new copper made available for domestic consumption may be estimated. This computation is made in the table that follows. It should be noted, however, that exports and stocks include some refined secondary copper that cannot be determined separately and that actual consumption of new copper would differ from the figures shown in the table by the changes in consumers' stocks on which data are not available.

New refined copper withdrawn from total year's supply on domestic account, 1932–36, in pounds

	1932	1933	1934	1935	1936
Total supply of new copper	848, 661, 722	752, 441, 910	945, 553, 301	1, 213, 753, 468	1, 654, 540, 642
Stock at beginning of year	924, 600, 000	1, 004, 000, 000	813, 000, 000	569, 000, 000	350, 000, 000
Total available supply	1, 773, 261, 722	1, 756, 441, 910	1, 758, 553, 301	1, 782, 753, 468	2, 004, 540, 642
Copper exported [1]	250, 058, 954	264, 742, 586	544, 276, 582	550, 012, 320	472, 182, 922
Stock at end of year	1, 004, 000, 000	813, 000, 000	569, 000, 000	350, 000, 000	220, 000, 000
	1, 254, 058, 954	1, 077, 742, 586	1, 113, 276, 582	900, 012, 320	692, 182, 922
Withdrawn on domestic account	519, 202, 768	678, 699, 324	645, 276, 719	882, 741, 148	1, 312, 357, 720

[1] Includes refined copper in ingots, bars, rods, or other forms.

As shown in the foregoing table, the quantity of new copper withdrawn on domestic account in 1936 was 49 percent above that in 1935 and 26 percent below that in the record year 1929.

Total supply.—Adding 969,200,000 pounds of secondary copper and copper in alloys produced during the year to the 1,312,400,000 pounds of new refined copper withdrawn on domestic account gives a total supply of 2,281,600,000 pounds of new and old copper available for domestic consumption in 1936. The secondary copper, however, includes remelted new scrap as well as old scrap. The new scrap represents a revolving supply required in manufacturing, so that a more significant figure of supply available for domestic consumption is obtained by adding to the new refined copper only the secondary copper derived from old scrap (765,400,000 pounds). The total available for consumption by this calculation would be 2,077,800,000 pounds in 1936 compared with 1,606,000,000 pounds in 1935 and 2,587,000,000 in 1929.

Industrial use of copper.—The American Bureau of Metal Statistics estimates the actual consumption of new and old copper in the United States by uses. Data for the past 5 years are shown in the accompanying table.

Estimated use of copper in the United States, 1932–36, in short tons

	1932	1933	1934	1935	1936
Electrical manufactures [1]	90,000	90,000	101,000	128,000	164,000
Telephones and telegraphs	27,000	18,000	18,000	18,000	26,000
Light and power lines [2]	49,000	33,000	36,000	55,500	72,000
Wire cloth	4,200	5,000	4,600	5,600	6,500
Other rod and wire	30,000	46,000	40,000	48,000	90,000
Ammunition	3,900	10,500	13,500	13,700	11,900
Automobiles [3]	32,300	49,000	63,000	95,000	108,000
Buildings [4]	29,000	36,000	36,000	49,000	71,000
Castings, n. e. s.[5]	27,000	36,000	36,000	36,000	39,000
Clocks and watches	1,500	2,800	2,200	2,400	3,400
Coinage	100	100	900	1,500	2,000
Copper-bearing steel	800	1,500	2,100	2,300	3,900
Fire-fighting apparatus	1,000	1,100	1,000	1,200	1,300
Radiators, heating	1,000	2,400	1,000	1,100	2,000
Radio receiving sets	7,000	11,500	12,500	16,000	24,000
Railway equipment [6]	700	800	2,100	1,800	4,000
Refrigerators [7]	9,000	11,400	15,700	15,400	15,000
Shipbuilding [7]	2,100	1,800	3,200	1,100	5,000
Washing machines [7]	1,500	1,000	1,400	1,300	1,500
Water heaters, household	1,000	1,500	1,500	1,500	1,500
Air conditioning [7] [8]			3,800	4,800	6,400
Other uses	27,300	40,000	42,000	46,000	59,000
Manufactures for export	22,600	15,600	25,500	29,500	31,600
	368,000	415,000	463,000	574,700	749,000

[1] Generators, motors, electric locomotives, switchboards, light bulbs, etc.
[2] Transmission and distribution wire and bus bars; accounting only for the public utility companies.
[3] Does not include starter, generator, and ignition equipment.
[4] Excludes electrical work.
[5] Bearings, bushings, lubricators, valves, and fittings.
[6] Includes air conditioning, beginning with 1933.
[7] Exclusive of electrical equipment.
[8] Other than railway.

The foregoing table indicates that the use of copper in 1936 increased 30 percent over that in 1935, with virtually all items sharing in the improvement, but that the total still was 35 percent below consumption in 1929. Electrical manufactures increased 28 percent over those of 1935 but were 37 percent below those in 1929. Telephones and telegraphs gained 44 percent in 1936, but made one of the poorest showings in relation to 1929, having fallen 84 percent from that year. Light and power lines were 30 percent above 1935 but 43 percent below 1929. Other wire fared much better, with consumption in 1936 88 percent above 1935 and only 15 percent below 1929. Automobiles, exclusive of starter, generator, and ignition equipment, took 14 percent more copper than in 1935 but 22 percent less than in 1929. The best showings of the year were made by building and radio uses, which made new high records in 1936. Building, exclusive of electrical work, used 45 percent more copper in 1936 than in 1935 and 20 percent more than in 1929. Radio receiving sets used 50 percent more copper than in 1935 and 55 percent more than in 1929.

STOCKS

The following table gives domestic stocks of copper reported by smelters and refineries.

Stocks of copper in the United States, Jan. 1, 1930–37, in pounds

Year	Refined copper	Blister and materials in process of refining	Year	Refined copper	Blister and materials in process of refining
1930	306,000,000	500,000,000	1934	813,000,000	388,000,000
1931	615,000,000	450,000,000	1935	569,000,000	389,000,000
1932	924,600,000	348,000,000	1936	350,000,000	472,000,000
1933	1,004,000,000	378,000,000	1937	220,000,000	391,000,000

Stocks of refined copper at refineries in the United States declined sharply in 1936 and were the smallest recorded since the end of 1928, according to reports submitted to the Bureau of Mines. They were only 22 percent of the record stocks on hand at the end of 1932. Stocks of blister copper and of materials in process of refining also were lower than for 1935 but were somewhat higher than the quantities on hand at the end of 1932, which, however, were not record stocks for this class. The decline in stocks of refined copper in 1936 was due mainly to the excess of apparent domestic consumption over production and to the increase in exports of domestic copper in that year. What portion of stocks at refineries may have been transferred to consumers' plants cannot be determined, as data covering consumers stocks are not available.

Figures of the Copper Institute, quoted in the press, indicated that world stocks of copper declined from 485,000 short tons at the beginning of 1936 to 353,000 at the close of the year. The former figure comprised 231,000 tons held in the United States and 254,000 tons held elsewhere. At the end of 1936 the United States held 161,000 and the rest of the world 192,000 tons. Thus, according to this authority, stocks of refined copper in the United States declined 30 percent, whereas those of the rest of the world fell 24 percent. The figures for the United States presumably include some metal held by or for consumers, as reports to the Bureau of Mines from refineries indicate that producers' stocks of refined copper, as shown in the preceding table, were 175,000 and 110,000 tons, respectively, at the beginning and end of 1936.

PRICES

Reports to the Bureau of Mines from copper-selling agencies in the United States indicate that 1,535,000,000 pounds of copper were delivered to domestic and foreign purchasers in 1936 at an average price (f. o. b. refinery) of 9.2 cents per pound. These deliveries are exclusive of copper produced and delivered outside of the United States. The average price for 1936 was 0.9 cent higher than that received in 1935 and nearly 3 cents higher than that for 1932, the lowest on record.

The average quoted monthly price for electrolytic copper, domestic f. o. b. refinery, according to the Engineering and Mining Journal, remained at 9.025 cents a pound throughout the first quarter of the year. In response to record-breaking sales, the price began to advance in April at a comparatively slow pace and averaged 9.525 cents for August and September. The upward movement of prices was considerably sharper in the final quarter of the year, and the average for December was 10.76 cents. On December 31 the price stood at 11.775 cents, and the forward surge that carried it to that level swept

it upward to 16.775 cents a pound on March 31, 1937. The movement of prices in the last months of 1936 and early in 1937 is to be contrasted with the relatively minor variations in copper quotations from the second quarter of 1933 through the third quarter of 1936.

One of the outstanding features of the price situation in 1936 was the return of the domination of the London price over the domestic price. As will be noted from the accompanying table, beginning with September, the average London price for copper was higher than the domestic price, despite the tariff of 4 cents a pound on metal imported. The price increases in the United States from then on followed rapid advances in the London market.

Average monthly quoted prices of electrolytic copper for domestic and export shipments, f. o. b. refineries, United States, and for spot copper at London, 1935–36, in cents per pound

Month	1935				1936			
	Domestic f. o. b. refinery [1]	Domestic f. o. b. refinery [2]	Export f. o. b. refinery [2]	London spot [2] [3]	Domestic f. o. b. refinery [1]	Domestic f. o. b. refinery [2]	Export f. o. b. refinery [2]	London spot [2] [3]
January	8.87	8.775	6.583	6.828	9.12	9.025	8.358	8.593
February	8.87	8.775	6.341	6.580	9.12	9.025	8.566	8.810
March	8.87	8.775	6.526	6.739	9.12	9.025	8.708	8.927
April	8.87	8.775	7.328	7.506	9.28	9.169	8.849	9.076
May	8.87	8.775	7.794	8.015	9.37	9.275	8.819	9.061
June	8.77	8.634	7.307	7.499	9.37	9.275	8.790	9.043
July	7.87	7.775	7.350	7.583	9.47	9.352	8.993	9.244
August	8.10	7.979	7.738	7.982	9.62	9.525	9.297	9.508
September	8.65	8.504	8.146	8.354	9.62	9.525	9.523	9.728
October	9.07	8.967	8.514	8.678	9.68	9.563	9.669	9.905
November	9.12	9.025	8.414	8.662	10.29	10.161	10.349	10.576
December	9.12	9.025	8.414	8.650	10.89	10.763	10.835	11.035
Average for year	8.76	8.649	7.538	7.753	9.58	9.474	9.230	9.465

[1] As reported by the American Metal Market Co.
[2] As reported by Engineering and Mining Journal.
[3] Conversion of English quotations into American money based on average rates of exchange recorded by the Federal Reserve Board of the Treasury.

Average yearly quoted prices of electrolytic copper for domestic and export shipment, f. o. b. refineries, United States, and for spot copper at London, 1927–36, in cents per pound

	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936
Domestic f. o. b. refinery [1]	13.05	14.68	18.23	13.11	8.24	5.67	7.15	8.53	8.76	9.58
Domestic f. o. b. refinery [2]	12.920	14.570	18.107	12.982	8.116	5.555	7.025	8.428	8.649	9.474
Export f. o. b. refinery [2]	([3])	([3])	([3])	([3])	([3])	([3])	6.713	7.271	7.538	9.230
London spot [2] [4]	13.468	15.040	18.413	13.355	8.522	5.629	6.877	7.496	7.753	9.465

[1] As reported by the American Metal Market Co.
[2] As reported by Engineering and Mining Journal.
[3] Not available. Export quotation was established after imposition of tariff in 1932.
[4] Conversion of English quotations into American money based on average rates of exchange recorded by the Federal Reserve Board of the Treasury.

FOREIGN TRADE [2]

United States imports and exports of copper constitute a well-balanced trade, through which the smelting, refining, and manufacturing facilities of this country are utilized to treat foreign raw materials and to return refined copper and manufactures of copper abroad.

[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Ninety-seven percent by weight of the copper imported in 1936 was contained in ore, concentrates, and unrefined furnace products. Much of the remainder—probably most of it—though already refined, consisted of ingots to be remelted and recast in the United States. By contrast, 94 percent of the exports consisted of refined copper and primary manufactures therefrom.

Separation of total exports to show the quantity of domestic copper shipped from the United States is not possible. Data at hand, however, indicate that much more domestic metal was exported in 1936 than in 1935, the excess of total exports over imports of unmanufactured copper being 144,000,000 pounds in 1936 compared with 91,000,000 pounds in 1935. In addition to the copper shown in the accompanying tables, an unrecorded quantity of metal is exported in manufactures, such as electrical machinery.

Imports.—Total imports of unmanufactured copper fell 26 percent—from 514,000,000 pounds in 1935 to 381,000,000 pounds in 1936. The major part of the decline was in receipts of unrefined copper, which were 120,000,000 pounds less than in 1935. Lower receipts of unrefined copper from Canada, Mexico, and Chile were mainly responsible for the drop in imports of this class. Imports of copper in the form of ore and concentrates were larger in 1936 than in the preceding year. Refined copper, imported chiefly from Chile, dropped from 36,142,671 pounds in 1935 to 9,563,232 pounds in 1936.

Copper (unmanufactured) imported into the United States in 1936, in pounds [1]

Country	Ore (copper content)	Concentrates (copper content)	Regulus, black, or coarse copper, and cement copper (copper content)	Unrefined black blister and converter copper in pigs or converter bars	Refined in ingots, plates, or bars	Old and scrap copper fit only for remanufacture, and scale and clippings
Africa:						
British:						
Union of South	24,200	64,330		22,458		
Other South		33,308				
Mozambique		326,554				
Australia	147,840	1,567,544	17,200			
Canada	800,490	22,627,311	1,425,527	1,195,285	1,278	1,921,913
Chile	10,356,781	4,234,972	8,418	94,698,829	9,111,512	352,628
Cuba	48,157	23,519,240				80,000
France			236,854	43,512		
Germany						50
Mexico	2,206,470	489,277		66,759,382		7,248
Peru	876,188	178,185	74,068	69,271,448	448,010	
Spain			53,128			
United Kingdom			1,135,743		1,946	6,000
Venezuela						61,297
Yugoslavia				38,065,983		
Other	11,548,070	8,398,154	725,542	6,216,023	486	788,861
	26,008,196	61,938,875	3,676,480	276,272,920	9,563,232	3,217,997

[1] Data include copper imported for immediate consumption plus material entering the country under bond.

Copper (unmanufactured) imported into the United States, 1932–36, in pounds

1932	391,991,342	1935	[1] 514,364,526
1933	287,433,540	1936	[1] 380,677,700
1934	[1] 426,571,568		

[1] Data include copper imported for immediate consumption plus material entering the country under bond as do figures for earlier years.

Exports.—Exports of copper of all classes totaled nearly 525,000,000 pounds in 1936. The exports were thus 13 percent below those for 1935 but, because of the larger drop in imports, actually indicate an increase in net exports of copper. Lower exports of refined copper bars and ingots, the most important class, were mainly responsible for the drop in the total.

Most of the copper shipped from the United States goes to Europe. Exports to France and Germany were 86,000,000 and 80,000,000 pounds, respectively, increases from 65,000,000 pounds for each country in 1935. Quantities shipped to United Kingdom and Italy dropped sharply from 110,000,000 and 91,000,000 pounds, respectively, to 62,000,000 and 48,000,000 pounds. Shipments to Japan also fell abruptly, from 110,000,000 pounds in 1935 to 80,000,000 in 1936.

Copper exported from the United States in 1936, in pounds

Country	Ore, concentrates, composition metal, and unrefined copper (copper content)	Refined		Old and scrap	Pipes and tubes	Plates and sheets	Wire (except insulated)	Insulated wire and cable	Other copper manufactures
		Bars, ingots, or other forms	Rods						
Belgium	334,242	29,413,309	2,471,445	977,137	2,179		54,778	77,399	
Canada	100	380,133	522,440	387,377	324,812	245,633	73,006	323,375	
China	4,004	5,095,715	276	67,301	688	21,296	222,899	410,499	
Denmark		3,712,794			3,165			7,870	
France		81,743,750	674,139	3,465,672	3,147	278,986	638	16,307	
Germany	224,000	65,278,609	77,480	13,947,584		45,247	389,915	723	
India (British)	79,830	470,431	2,752,566		62,497	652,392	18,312	356,911	
Italy		47,700,894			4,020	10,225		645	(1)
Japan	702	79,852,142	55		1,752	65,927	116,675	28,533	
Netherlands		6,511,484	4,794,061	1,476,332	7,965	13,269	7,501	13,453	
Norway		3,074,633	6,540,073		1,379			10,000	
Spain				5,355,471	4,653			21,529	
Sweden		31,012,143			2,817	1,165		35,359	
United Kingdom	30,290	61,096,301	226,919	668,505	6,429	246,477	40,253	101,847	
Other countries	[2] 6,096,035	[3] 25,438,592	13,342,538	101,841	1,270,442	639,882	3,367,391	9,821,929	
	6,769,203	440,780,930	31,401,992	26,447,220	1,695,945	2,220,499	4,291,368	11,226,379	(1)
Total value	$468,961	$40,702,493	$3,174,732	$2,233,105	$353,136	$367,157	$490,065	$2,287,982	$585,568

[1] Figures for quantity not recorded.
[2] Includes 6,065,812 pounds exported to Mexico.
[3] Includes 3,809,997 pounds exported to Mexico.

Copper exported from the United States (all forms), by principal countries of destination, 1932–36, in millions of pounds

Destination	1932	1933	1934	1935	1936
Belgium	18	33	27	31	33
Canada	2	1	1	1	2
France	75	104	131	65	86
Germany	50	44	83	65	80
India (British)	2	2	12	12	4
Italy	49	30	55	91	48
Japan	3	36	119	110	80
Netherlands	13	15	27	21	13
Sweden	16	12	29	25	31
United Kingdom	73	29	84	110	62
Others	27	43	57	75	86
	328	349	625	606	525

Copper [1] exported from the United States, 1932–36

Year	Pounds		Total value	Year	Pounds		Total value
	Metallic [2]	Total			Metallic [2]	Total	
1932	295, 356, 719	328, 222, 700	$20, 998, 816	1935	590, 396, 106	605, 746, 050	$48, 363, 303
1933	303, 825, 790	349, 253, 716	24, 639, 027	1936	518, 064, 333	524, 833, 536	50, 077, 631
1934	592, 718, 891	625, 485, 074	49, 263, 566				

[1] Exclusive of "Other copper manufactures" valued at $237,004 in 1932, $278,229 in 1933, $500,974 in 1934, $570,061 in 1935, and $585,568 in 1936; quantity not recorded.
[2] Exclusive of ore, concentrates, and composition metal. Exclusive also of unrefined copper, figures for which are not separable from those for ore and concentrates.

Copper sulphate (blue vitriol) exported from the United States, 1932–36

Year	Pounds	Value	Year	Pounds	Value
1932	4, 132, 529	$114, 579	1935	4, 508, 271	$142, 467
1933	2, 749, 299	92, 964	1936	10, 734, 408	342, 847
1934	3, 858, 629	128, 756			

Brass and bronze exported from the United States, 1935–36

	1935		1936	
	Pounds	Value	Pounds	Value
Ingots	202, 302	$17, 979	349, 540	$33, 182
Scrap and old	59, 584, 959	3, 299, 546	24, 679, 293	1, 563, 511
Bars and rods	1, 582, 491	250, 682	1, 814, 456	312, 405
Plates and sheets	544, 560	114, 020	548, 762	116, 948
Pipes and tubes	995, 106	188, 379	1, 390, 991	299, 889
Pipe fittings and valves	1, 435, 895	818, 042	1, 904, 774	1, 062, 352
Plumber's brass goods	752, 526	384, 776	930, 306	480, 314
Wire of brass or bronze	375, 053	96, 853	565, 413	140, 726
Brass wood screws	(1)	20, 258	(1)	30, 870
Hinges and butts of brass or bronze	(1)	37, 832	(1)	47, 925
Other hardware of brass or bronze	(1)	265, 680	(1)	296, 377
Other brass and bronze manufactures	(1)	1, 144, 016	(1)	1, 282, 678
		6, 638, 063		5, 667, 177

[1] Weight not recorded.

Unmanufactured brass exported from the United States, 1932-36

[Ingots, bars, rods, plates, and sheets]

Year	Pounds	Value	Year	Pounds	Value
1932	1,843,358	$242,167	1935	2,329,353	$382,681
1933	1,164,709	180,155	1936	2,712,758	362,535
1934	1,855,305	327,685			

WORLD ASPECTS OF COPPER INDUSTRY

International cooperation.—As indicated in Minerals Yearbook, 1936, the international curtailment agreement, which embraced the larger copper producers outside of the United States, was renewed in April 1936 to run until July 1, 1938. It was largely owing to this agreement that production declined or was relatively stationary in most of the important producing countries. The notable increase in production in the United States in 1936 was chiefly responsible for the increase in world output in that year. Under the agreement output rates were raised five times in the latter part of 1936, beginning August 1, to meet increasing demands for the metal. Members of the agreement were operating at 70 percent of their quota basis (far below actual capacity) through July. The production rate was increased 5 percent each on August 1, October 1, and October 15, and 10 percent each on November 1 and November 5, so that at the end of the year producers were operating at 105 percent of their quota basis. Early in January 1937 all restrictions on production were removed in an effort to satisfy consumption and speculation demands.

World smelter production.—World smelter production increased 18 percent in 1936 mainly because of the large gain in output in the United States, although there was an increase of 5 percent in output outside of the United States. United States smelter production from domestic ores was 60 percent larger in 1936 than in 1935 but amounted to only 61 percent of the total for 1929, whereas the output of the remainder of the world increased 5 percent in 1936 and was 133 percent of that for 1929. Thus, despite the large gain in production in the United States in 1936, United States smelter output has declined sharply in relation to the world total since 1929. In the countries that stood next to the United States in importance in 1936, production in Chile, Canada, and Rhodesia fell 6 percent, 1 percent, and 1 percent, respectively. The outputs of Chile and Canada, however, were 81 and 239 percent of their 1929 totals, while Rhodesia's tonnage in 1929 was insignificant. The comparison would doubtless have been more unfavorable to the United States had it not been for the international curtailment agreement. Smelter production increased in Japan U. S. S. R. (Russia), Germany, and Peru in 1936, the increase in U. S. S. R. being of notable proportions.

World smelter production of copper, 1932–36, in metric tons

[Compiled by M. T. Latus]

Country [1]	1932	1933	1934	1935	1936
North America:					
Canada [2]	95,710	118,109	151,818	175,467	173,412
Mexico	[3] 34,000	39,600	47,100	41,200	[3] 28,000
United States [4]	278,997	227,223	251,225	378,626	592,645
	408,707	384,932	450,143	595,293	794,057
South America:					
Chile	97,517	157,232	247,721	259,930	244,664
Peru	22,531	24,679	28,033	30,387	32,768
	120,048	181,911	275,754	290,317	277,432
Europe:					
Austria	1,987	1,000	597	1,337	1,800
Belgium [5]	26,950	35,360	61,100	81,720	(6)
Czechoslovakia	936	779	633	941	(6)
France	995	710	1,000	1,280	(6)
Germany [7]	50,900	49,800	53,000	56,000	59,000
Italy	427	120	303	64	(6)
Norway	5,416	6,694	7,989	8,438	(6)
Rumania [8]	109	453	202	978	(6)
Spain	15,555	17,268	13,777	11,562	(6)
Sweden [9]	3,138	6,638	7,854	8,427	(6)
United Kingdom [10]	13,000	11,300	11,380	12,600	(6)
U. S. S. R. (Russia) [11]	30,678	32,690	44,081	63,247	77,600
Yugoslavia	30,159	40,318	44,390	39,000	39,400
	[11] 180,250	[11] 203,130	[11] 246,306	[11] 285,594	(6)
Asia:					
China [12]	16	36	(13)	----------	(6)
Chosen	694	785	1,434	2,170	(6)
India, British	4,514	4,900	6,400	7,000	(6)
Japan	71,877	69,033	67,002	70,914	78,114
U. S. S. R. (Russia) [11]	(11)	(11)	(11)	(11)	(11)
	[11] 77,101	[11] 74,754	[11] 74,836	[11] 80,084	(6)
Africa:					
Belgian Congo	[3] 54,000	66,596	110,085	107,682	(6)
Rhodesia:					
Northern	68,977	105,877	140,110	145,804	144,617
Southern	6	----------	----------	----------	----------
Union of South Africa	9,387	8,378	8,328	11,633	10,050
	132,370	180,851	258,523	265,119	(6)
ceania: Australia	13,521	11,418	8,098	11,347	(6)
	932,000	1,037,000	1,314,000	1,528,000	[14] 1,800,000

[1] In addition to the countries listed, copper is smelted in Turkey, but data of output are not available.
[2] Copper content of blister produced.
[3] Approximate production.
[4] Smelter output from domestic and foreign ores, exclusive of scrap. The production from domestic ores only, exclusive of scrap, was as follows: 1932, 246,757 tons; 1933, 204,115 tons; 1934, 221,558 tons; 1935, 345,902 tons; 1936, 554,659 tons.
[5] Figures represent blister copper only. In addition to blister copper, Belgium reports a large output of refined copper which is not included above as it is believed produced principally from crude copper from the Belgian Congo and would, therefore, duplicate output reported under the latter country.
[6] Data not yet available.
[7] Exclusive of material from scrap. (Metallgesellschaft, Stat. Zusammenstell.)
[8] Smelter output from ores.
[9] Exclusive of material from scrap.
[10] Approximate production. (Imp. Inst., London.)
[11] Output from U. S. S. R. in Asia included under U. S. S. R. in Europe.
[12] Exports of ingots and slabs.
[13] Less than 1 ton.
[14] Approximate production, based on the output of the countries shown, which in 1935 contributed nearly 83 percent of the total world output.

World mine production.—Statistics of mine production are of interest, as they show the original sources of the world supply of copper more accurately than smelter figures. The following table, which shows mine production during the past 5 years, is compiled largely from official data, many of which are not yet available for 1936.

World mine production of copper, 1932–36, in metric tons

[Compiled by M. T. Latus]

Country	1932	1933	1934	1935	1936
North America:					
Canada	112,345	136,069	165,452	190,053	190,926
Cuba	5,927	8,957	6,192	6,960	11,631
Mexico	35,213	39,825	44,268	39,373	29,713
Newfoundland	2,153	3,162	3,859	2,956	5,336
United States	216,010	172,948	215,369	346,806	[1] 545,000
	371,648	360,961	435,140	586,148	782,606
South America:					
Bolivia [2]	2,017	1,849	1,622	1,913	([3])
Chile	103,173	163,395	256,700	267,083	245,279
Peru	22,890	24,874	27,735	29,653	32,585
	128,080	190,118	286,057	298,649	([3])
Europe:					
Austria	171	133	83	55	12
Bulgaria	2		4	5	2
Finland	6,649	11,362	8,437	11,987	([3])
France	435	226	330	[1] 300	([3])
Germany	30,741	29,434	25,970	27,420	([3])
Greece		2	129	50	([3])
Hungary	278	315	228	244	116
Italy	381	329	394	335	([3])
Norway	16,944	19,879	21,122	19,708	([3])
Portugal [1]	2,000	2,000	2,000	2,000	2,000
Rumania [4]	109	453	202	978	([3])
Spain	35,000	44,000	33,000	30,000	([3])
Sweden	4,309	6,871	5,099	6,388	([3])
U. S. S. R. (Russia)	[5] 32,000	[5] 32,700	[5] 44,100	[5] 61,000	([3])
United Kingdom	62	41	14	51	([3])
Yugoslavia	18,946	35,304	43,000	41,700	([3])
	[5] 148,027	[5] 183,000	[5] 184,000	[5] 202,000	([3])
Asia:					
China	440	483	471	[1] 500	([3])
Cyprus	3,300	4,300	4,100	12,428	([3])
India, British	11,400	10,900	11,700	11,278	([3])
Japan:					
Japan proper [4]	71,877	69,033	67,002	70,914	78,114
Chosen [4]	694	785	1,434	2,170	([3])
Taiwan	4,417	[1] 4,000	[1] 4,000	[1] 4,000	([3])
U. S. S. R. (Russia)	([5])	([5])	([5])	([5])	([3])
	[5] 92,128	[5] 89,501	[5] 89,000	[5] 101,000	([3])
Africa:					
Algeria	18	17	140	20	([3])
Belgian Congo [4]	[6] 54,000	66,596	110,085	107,682	([3])
French Equatorial Africa	150	3,000	110	([3])	([3])
Rhodesia:					
Northern	88,639	131,500	160,128	171,366	([3])
Southern [4]	6				([3])
South-West Africa [7]	2,400				([3])
Union of South Africa	9,403	8,383	7,862	10,698	9,068
	155,000	209,000	278,000	290,000	([3])
Oceania: Australia	14,893	14,644	12,205	17,263	([3])
	909,000	1,047,000	1,284,000	1,495,000	([3])

[1] Approximate production.
[2] Copper content of exports.
[3] Data not yet available.
[4] Smelter product.
[5] Output from U. S. S. R. in Asia included under U. S. S. R. in Europe.
[6] Fine copper content of smelter output.
[7] Year ended Mar. 31 of year following that stated.

World consumption.—World consumption of copper in 1936 is estimated by the American Bureau of Metal Statistics at 2,072,000 short tons, an increase of 15 percent over 1935 and, with the exception of 1929, the highest on record. Had the use of copper in the United States equaled that in 1929, the world total would have been consider-

ably above that for 1929. According to the authority mentioned, consumption in the United States increased 40 percent in 1936 but was 28 percent below the record for 1929. Copper used in the remainder of the world in 1936 was 4 percent above the record consumption for 1935 and 32 percent larger than in 1929. Greater use of copper was evident in all of the major consuming countries of the world except Germany, Japan, and Italy. Germany's consumption was reduced by substitution and by Government restriction of the use of copper to necessities. The reduction in Italy followed a record year of use in 1935 and coincided with the termination of war between Italy and Ethiopia. The decline in Japan may be explained by the increased use of scrap material, although consumption in Japan is far above the record for years prior to 1935 despite the drop in 1936. U. S. S. R. (Russia), which ranked seventh as a consumer in 1929, stood fourth in 1936, increasing the quantity used 151 percent in 1936 over that used in 1929.

REVIEW BY COUNTRIES

Belgian Congo.—Production in Belgian Congo continued at a curtailed rate in 1936 owing to the international restriction agreement. Productive capacity of Union Minière du Haut-Katanga is reported as 200,000 tons of copper, but output under the agreement totaled only 107,682 metric tons in 1935. Up to the end of 1935 about 1½ million tons of metal had been produced [3] from 25 million tons of ore, and the shareholders had received £7,000,000 in dividends. The principal concentrator is at Panda, and the smelter is at Lubumbashi, near Elisabethville. When the article was written an electrolytic leaching plant had just recently begun to operate at Panda to treat lower-grade sulphide ores. Refining of Union Minière copper is done at the two plants of the Société Générale Métallurgique de Hoboken in Belgium, one at Hoboken, near Antwerp, and the other at Oolen, in Belgian Limberg. At the latter place there is an electrolytic refinery of 110,000 tons annual capacity.

Canada.—Smelter production of copper in 1936 totaled 191,155 short tons, slightly under the record output of 193,420 tons in 1935, while the mine total of 210,461 tons was a little higher than the previous record output of 209,499 tons in 1935. Ontario mines contributed 68 percent of the mine total, Quebec 16 percent, Manitoba and Saskatchewan together 11 percent, and British Columbia 5 percent. Production in 1935 and 1936 is shown by Provinces in the following table:

Copper produced (mine output) in Canada, 1935–36, by Provinces, in pounds

	1935	1936		1935	1936
British Columbia	38,478,043	21,067,501	Quebec	79,050,906	66,340,175
Manitoba	38,011,371	29,853,220	Saskatchewan	11,429,452	14,971,609
Nova Scotia		779,307			
Ontario	252,027,928	287,910,908		418,997,700	420,922,720

Output in Ontario and Saskatchewan improved, but that in other districts declined. Nova Scotia produced a small quantity in 1936

[3] South African Mining and Engineering Journal, The Copper Belt of Central Africa: Vol. 47, no. 2269, July 25, 1936, p. 729.

compared with none in 1935. All the Ontario output is derived from the nickel-copper ores of the Sudbury district and consists of copper in converter copper made by International Nickel Co., Ltd., and of copper in copper matte exported by that company and the Falconbridge Nickel Mines, Ltd. The Copper Cliff smelter of International Nickel, whose capacity was increased one-third in 1936, produced 139,796 tons of blister copper, and 137,012 tons of refined copper were produced by the refining subsidiary, Ontario Refining Co., Ltd. New developments of importance were the installation of a 30-ton arc-type electric melting furnace and a scheme for transporting molten blister copper from the Copper Cliff smelter to the refinery, a distance of about 1 mile. The company claims that many costly steps from the smelter converters to the refinery anode furnaces are thus eliminated. Copper is secondary to nickel in International's operations, representing about 30 percent of the combined value of production of the two metals. The output of Quebec is mainly from Noranda, which lowered its production from 37,239 tons in 1935 to 31,375 tons in 1936. The Flin Flon mine, on the boundary between Manitoba and Saskatchewan, is entirely responsible for the output of these two Provinces. Preparations were under way for the reopening of the Sherritt-Gordon mine in Manitoba in 1937. After the closing of the Granby mine in August 1935, the Britannia mine at Howe Sound was the only important producer in British Columbia. In 1936 Granby began preparations for reopening its Copper Mountain mine, and this property is expected to come into production in 1937.

Canada exports a large part of its copper. In 1936, shipments included 23,000 tons of copper in ore, matte, etc., 155,000 tons of refined products, and 24,000 tons of rolled products. The United States was the principal recipient of the ore and matte. The United Kingdom took 69 percent of the refined copper.

Chile.—Copper production in 1936 totaled 244,664 metric tons, 15,266 tons less than in 1935, owing to the fact that Chilean producers were operating under the world production-curtailment agreement. Chile Copper produced 112,000 metric tons compared with 119,700 tons and Andes 27,000 tons compared with 26,000 tons. Braden produced 92,600 tons from ore having an average copper content of 2.19 percent compared with 101,600 tons in 1935. At Braden a monthly production rate of 7,683 short (7,000 metric) tons was maintained through July. Beginning with August, progressive increases were made until output reached an average of 11,525 short (10,500 metric) tons in November and December.

France.—France ranked sixth in copper consumption in the world in 1936, but it produces only an insignificant amount of either ore or metal. Consumption totaled 113,000 metric tons, an increase of 7 percent over the quantity used in 1935. In 1936 imports of unmanufactured copper totaled 118,000 tons compared with 105,000 tons in 1935. Of the 1936 total, 100,000 tons were refined and 18,000 tons unrefined copper. Chile supplied nearly 39,000 tons of the refined total and the United States, Belgium, and Canada 18,000 to 20,000 tons each.

Germany.—Germany's attempts to decrease the consumption of imported metals by substitution and restriction met with some success in 1936. While the consumption of copper in virtually all other large consuming countries either increased or was maintained at previous high levels, Germany consumed 25,000 metric tons (12 percent) less

copper than in 1935, the only decrease of any consequence in the world. According to Wright,[4] Germany has continued to operate the Mansfeld copper mines at a loss and thus supplied about one-tenth of her domestic copper requirements. German smelter output of copper in 1936 was 59,000 metric tons compared with 56,000 tons in 1935. Normally, more than half of the smelter output is from imported crude materials. Imports of metal fell from 153,000 tons in 1935 to 127,500 in 1936, of which more than half came from Belgian Congo and other Africa. Imports of foreign ores increased from 401,000 tons in 1935 to 482,000 in 1936, and of copper scrap from 20,000 to 24,000 tons.

Japan.—Smelter production of copper in Japan amounted to 78,114 metric tons, an increase of 10 percent over output in 1935. Although Japan was formerly self-sufficient with respect to its copper requirements and imported less than 300 tons in 1932, it imported 65,000 tons in 1935 and 48,000 in 1936. Japan's consumption of copper was reported to have declined to 127,500 tons in 1936 from the record-breaking total of 133,500 tons for 1935.

Mexico.—Smelter production is reported to have dropped from 41,200 metric tons in 1935 to about 28,000 tons in 1936, a continuation of the decline from 47,100 tons in 1934. Mine output was 39,373 tons in 1935 and fell to 29,713 tons in 1936. Boleo produced 7,095 tons in 1936 compared with 7,865 in 1935 and Cananea (Anaconda) 14,700 tons compared with 19,100. The Cananea property was closed down 2½ months early in 1936 because of labor difficulties. The Moctezuma mine of Phelps Dodge, idle since 1932, continued on a nonoperating basis in 1936.

Peru.—The Cerro de Pasco Copper Corporation reported the production of 71,482,061 pounds (32,424 metric tons) of copper in 1936, 12,640,051 ounces of silver, 45,087 ounces of gold, 19,620,151 pounds of lead, and 17,515 short tons (15,900 metric tons) of zinc concentrates. Production of the company in 1935 was 63,977,630 pounds (29,020 metric tons) of copper, 11,891,846 ounces of silver, 28,637 ounces of gold, 16,358,860 pounds of lead, and 16,174 short (14,700 metric) tons of zinc concentrates.

Northern Rhodesia.—Copper production in 1936 (144,617 metric tons) was slightly lower than the record output of 145,804 tons in 1935, because the producing companies were operating under the international curtailment agreement. The rate of production was speeded five times in the latter part of the year, beginning with August 1, in line with increases permitted by the members of the restriction agreement.

The Rhokana Corporation, Ltd., produced 50,399 long tons of copper in the year ended June 30, 1936; 25,057 tons was in the form of blister copper and 25,342 tons electrolytic copper. The average cost of production of blister copper was £22.345 and of electrolytic copper £25.346 a ton. These costs are exclusive of depreciation and debenture interest. Production in 1936 was, as usual, principally from the Nkana mine, where 1,564,564 short tons of ore carrying 3.775 percent copper were hoisted. The tonnage produced at the Mindola mine in connection with development work was 201,610 tons of an average grade of 3.617 percent copper. A recalculation of ore reserves resulted in estimates of 125,674,435 short tons of 3.50-percent copper ore for the Nkana mine and 143,780,000 tons of 4.66-percent ore for Nchanga

[4] Wright, Chas. Will, Germany's Nonferrous Mineral Industries: Special Suppl. 3, Mineral Trade Notes, Bureau of Mines, Sept. 19, 1936, p. 2.

mine. The estimate for Nkana includes reserves for the Mindola mine and that for Nchanga is unchanged from former estimates.

The refinery at the Nkana plant of Rhokana, completed in 1935, has been described by Wheeler and Eagle.[5]

A new subsidiary of the Rhokana Corporation, Nchanga Consolidated Copper Mines, Ltd., has been formed for the purpose of acquiring and developing the Nchanga and Chingola mining grants as well as certain contiguous mining grants. Since November 1936, preliminary work in connection with the dewatering of the properties and reconditioning of the plant has been proceeding.

The production of blister copper for Roan Antelope for the year ended June 30, 1936, amounted to 50,672 long tons compared with 67,316 long tons in the previous year. The company reported revenue from copper sales as £34.581 per long ton for the fiscal year 1936 compared with £27.926 for 1935 while costs, including debenture interest and depreciation, increased, owing to the restricted rate of production, from £23.174 in 1935 to £24.773 in 1936. The company estimated reserves of ore at the end of the fiscal year as 95,637,987 tons, containing an average of 3.43 percent copper.

The blister-copper production for the account of Mufulira amounted to 28,123 long tons for the year ended June 30, 1936, compared with 20,723 tons for the previous year. The average revenue from copper sales increased from £27.908 per long ton of blister in 1935 to £35.166 in 1936 while costs, including debenture interest and depreciation, declined from £33.141 to £30.281. The Mufulira smelter was almost completed when the fiscal year ended and was reported to be in operation early in 1937. Its estimated maximum capacity is reported as about 100,000 long tons of copper a year. The company estimated reserves at the end of June 1936 at 114,390,000 short tons of ore containing 4.39 percent copper in the Mufulira mine; 25,000,000 tons of 3.46-percent ore in the Chambishi mine; and 21,000,000 tons of 3.47-percent ore in the Baluba mine, a total of 160,390,000 tons, averaging 4.12 percent.

U. S. S. R. (Russia).—The mine production of Russia places it first in Europe as a source of copper. In smelter output in the past 2 years it has ranked second to Belgium, which imports all of its crude materials. Smelter output in 1936 was 77,600 metric tons, compared with 63,247 tons in 1935. According to the Metal Bulletin,[6] official Soviet estimates place copper reserves of the Soviet Union at 17,000,000 tons of copper.

Yugoslavia.—Mines de Bor, operated under French control, make Yugoslavia the second largest source of mine production of copper in Europe. The mine total for 1935 was 41,700 metric tons, but final data are not yet available for 1936. Smelter output was 39,400 tons in 1936 compared with 39,000 in 1935. A large part of Yugoslavia's crude copper has been refined in the United States. The company, however, plans to erect an electrolytic refinery in Yugoslavia to refine its own copper in the future.

---

[5] Wheeler, A. E. and Eagle, H. Y., The Rhokana Electrolytic Copper Refinery: Inst. Min. and Met. Bull. 379, London, April 1936, 19 pp.

[6] Metal Bulletin, no. 2152, Dec. 29, 1936, p. 4.

LEAD[1]

By Elmer W. Pehrson and H. M. Meyer

SUMMARY OUTLINE

The lead industry made further strides in 1936 in response to the marked recovery in industrial activity. Production, consumption, and prices were substantially above those in 1935, and considerable progress was made in liquidating the huge stocks accumulated during the depression. In short, the industry enjoyed its best year since 1931. A feature of 1936 was the notable increase in the use of lead in cable covering and building, although improvement in these industries still lags far behind that in other important industries using lead.

Salient statistics of the lead industry in the United States, 1925–29 (average) and 1932–36, in short tons

	1925–29 (average)	1932	1933	1934	1935	1936
Production of refined primary lead:						
From domestic ores	660,525	[1] 248,917	[1] 249,713	299,841	310,505	387,698
From foreign ores and base bullion	123,104	33,024	13,963	11,395	14,055	11,458
	783,629	[1] 281,941	[1] 263,676	311,236	324,560	399,156
Recovery of secondary lead:						
As pig lead	126,600	128,000	131,800	124,500	156,800	137,500
In alloys	153,400	70,300	92,700	83,900	113,600	125,400
	280,000	198,300	224,500	208,400	270,400	262,900
Total production of pig lead (primary and secondary)	910,229	[1] 409,941	[1] 395,476	436,736	481,360	536,656
Imports:[2]						
Lead in base bullion	95,747	13,462	1,587	[2] 2,450	[2] 2,692	[2] 312
Lead in ore	40,096	21,001	5,958	[2] 10,611	[2] 20,025	[2] 20,713
Exports of refined pig lead	98,048	23,516	22,835	5,909	6,982	18,314
Refined primary lead available for consumption	[1] 690,916	[1] 264,889	[1] 250,853	[1] 305,610	[1] 318,900	383,432
Estimated consumption of primary and secondary lead	900,250	416,700	449,500	488,000	538,900	633,550
Prices:						
New York:						
Average for year cents per pound	7.47	3.18	3.87	3.86	4.06	4.71
Quotation at end of year do	6.25	3.00	4.15	3.70	4.50	6.03
London average do	5.87	1.86	2.21	2.46	3.12	3.91
Mine production of recoverable lead	664,230	292,968	272,677	287,432	331,103	[3] 373,986
World smelter production of lead	1,850,000	1,279,000	1,276,000	1,454,000	1,538,000	1,626,000

[1] Revised figures.
[2] Data for 1934–36 include lead imported for immediate consumption plus material entering the country under bond as do figures for earlier years.
[3] Subject to revision.

[1] This report deals primarily with the smelting, refining, and consuming phase of the industry. For full details of mining operations see separate reports issued for the various States.

Virtually all gains in 1936 were made in the second half of the year. From January to July domestic shipments failed to maintain the level established during the closing months of 1935, and in consequence stocks increased. Despite this, however, the price advanced from 4.50 cents a pound (New York) at the beginning of the year to 4.60 cents toward the end of February. This quotation held until October. Beginning in July demand became stronger not only in the United States but in Europe, where speculative buying in anticipation of the enormous rearmament program announced by the British Government was a leading factor. London prices reacted immediately, but the New York quotation did not advance appreciably until the last of October. Although New York prices rose sharply during Novem-

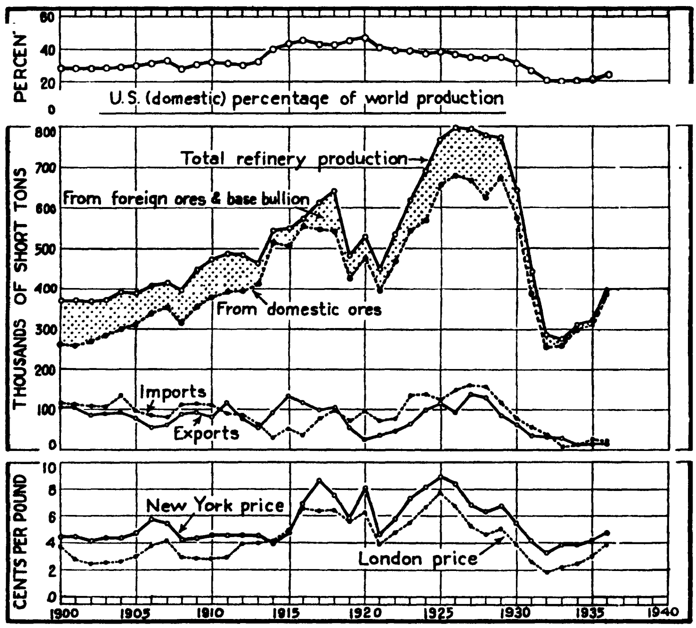


FIGURE 26.—Trends in the lead industry in the United States, 1900–1936. Imports include lead in ore, base bullion, and refined lead; exports include refined lead.

ber and December London prices rose faster, and by December exceeded those in New York for the first time since the World War. The differential between London and New York moved from 1.20 cents per pound in favor of New York in June to 0.03 cent in favor of London in December. At times during December it would have been profitable to export domestic lead to Europe, but apparently little or no lead was exported. At the close of the year quotations were 6.03 cents in New York and 6.21 cents in London. Domestic shipments exceeded production during the last half of the year by 60,000 tons. Figure 26 shows trends in the domestic lead industry from 1900 to 1936.

At the end of 1936 stocks of refined lead on hand in the United States totaled about 165,000 short tons, or approximately a 3-month supply. Although this is considerably above normal, price movements in the latter part of 1936 showed that the stocks were strongly

held and did not necessarily constitute a serious hazard to reasonable price appreciation. Moreover, these excess stocks proved of real value to the industry early in 1937, as they were an important factor in preventing exorbitant prices, which most producers agree would have been detrimental to the industry in the long run.

Outside the United States recovery over 1935 in production and consumption was not so pronounced. For example, domestic production increased 23 percent, whereas that abroad increased only 1 percent. Consumption likewise was 20 percent higher in the United States and only 7 percent higher elsewhere. Compared with predepression levels, however, domestic consumption in 1936 lagged considerably, being approximately a third below 1929, whereas abroad it was 12 percent above. The more favorable London price in 1936 was due to the smaller stocks held abroad when the buying wave started, cessation of supplies from Spain due to the civil war, and threatened curtailment elsewhere on account of labor troubles.

Trends in lead consumption.—Figure 27 compares the trend in lead consumption from 1929–36 with that of copper and zinc and with the general index of industrial activity. It will be noted that general

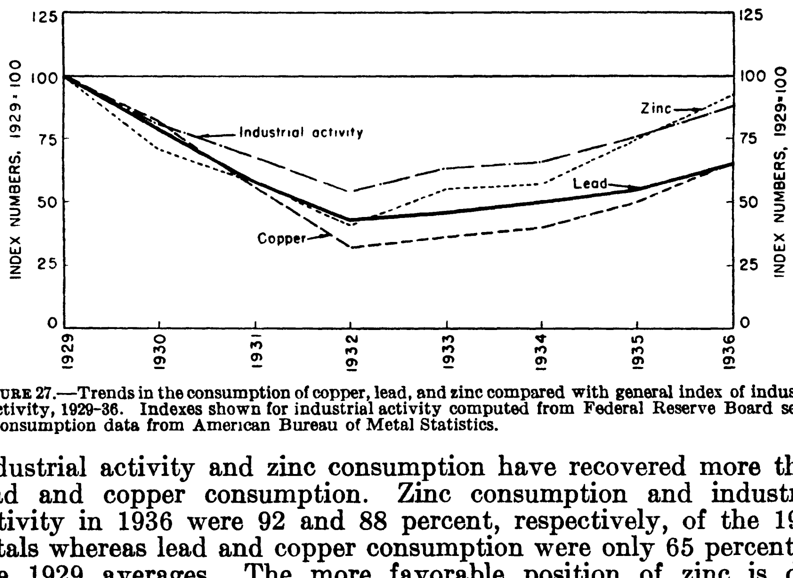


FIGURE 27.—Trends in the consumption of copper, lead, and zinc compared with general index of industrial activity, 1929–36. Indexes shown for industrial activity computed from Federal Reserve Board series. Consumption data from American Bureau of Metal Statistics.

industrial activity and zinc consumption have recovered more than lead and copper consumption. Zinc consumption and industrial activity in 1936 were 92 and 88 percent, respectively, of the 1929 totals whereas lead and copper consumption were only 65 percent of the 1929 averages. The more favorable position of zinc is due primarily to the fact that most of the output is used in consumer goods, production of which has progressed rapidly with returning prosperity. On the other hand, lead and copper are used largely in durable goods, and the hesitancy with which capital has been invested in new plant and equipment has retarded the use of these metals, particularly in the utility and building fields.

The effect of slow recovery in the utility and building industries on consumption of lead is shown in figure 28. Lead-covered cable is used extensively in the communications field and normally is one of the most important uses for lead. In 1929 it ranked first, taking 220,000 tons (23 percent) of the total lead consumed in that year. This outlet for lead, however, was the hardest hit of any of the major lead-consuming industries during the depression. By 1933 the tonnage had

declined to 31,400, and since then has increased to only 61,400 tons; most of the advance was credited to 1936, in which year cable covering consumed 10 percent of the total. The use of lead in building likewise has slumped severely—from 96,000 tons in 1929 (10 percent of the total) to 22,000 tons in 1932 with a subsequent rise to only 40,000 tons in 1936. Consumption of lead for all other purposes, which include pigments, storage batteries, ammunition, foil, alloys, etc., has improved surprisingly; the tonnage used in 1936 was 81 percent of the 1929 total. These purposes took 84 percent of all the lead used in 1936 compared with only 67 percent in 1929. Obviously, however, full return of lead consumption to predepression levels requires substantial improvement in the building and utility fields.

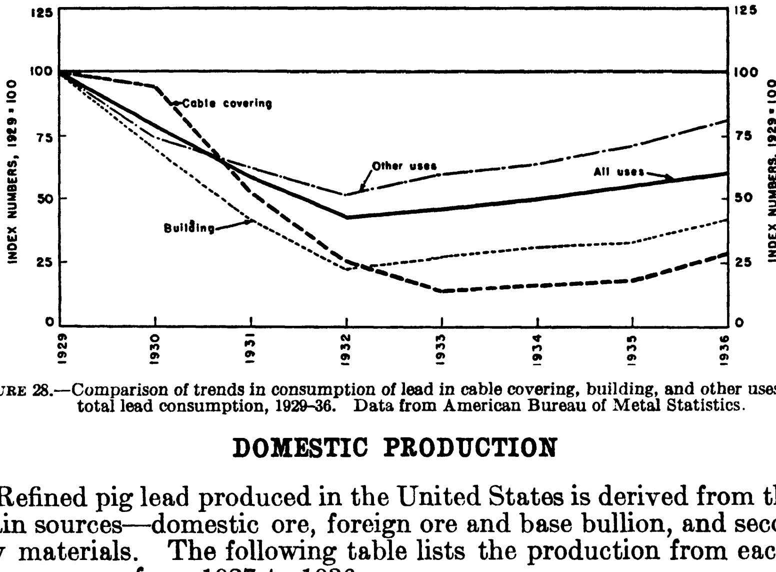


FIGURE 28.—Comparison of trends in consumption of lead in cable covering, building, and other uses with total lead consumption, 1929–36. Data from American Bureau of Metal Statistics.

DOMESTIC PRODUCTION

Refined pig lead produced in the United States is derived from three main sources—domestic ore, foreign ore and base bullion, and secondary materials. The following table lists the production from each of these sources from 1927 to 1936.

Total pig lead produced in the United States, 1927–36, in short tons

Year	From domestic ores and base bullion	From foreign ores and base bullion	From secondary materials	Total
1927	668,320	128,210	119,000	915,530
1928	626,202	154,869	138,000	919,071
1929	672,498	102,135	138,500	913,133
1930	573,740	69,293	129,000	772,033
1931	390,260	52,504	128,800	571,564
1932	[1] 248,917	33,024	128,000	[1] 409,941
1933	[1] 249,713	13,963	131,800	[1] 395,476
1934	299,841	11,395	124,500	435,736
1935	310,505	14,055	156,800	481,360
1936	387,698	11,458	137,500	536,656

[1] Revised figures.

PRIMARY LEAD

Refinery production.—Production of refined primary lead in 1936 increased 23 percent; it was equivalent to the production in 1905 but was 49 percent below the 1925–29 average. The production of lead

derived from domestic ores increased about 25 percent in 1936. Production from foreign ores and base bullion decreased 18 percent and was equivalent to only 11 percent of the 1929 output; it accounted for only 3 percent of the total output of refined primary lead.

Refined primary lead produced in the United States, 1929–36

Year	Production [1] (short tons)				Sources (short tons)			Value	
	Desilverized lead [1] [2]	Soft lead [3] Desilverized	Soft lead [3] Undesilverized	Total production [1]	From domestic ores and base bullion	From foreign ores	From foreign base bullion	Average per pound	Total
1929	483,622	55,666	235,345	774,633	672,498	29,675	72,460	$0.063	$97,604,000
1930	396,094	45,578	201,361	643,033	573,740	34,348	34,945	.050	64,303,000
1931	263,919	40,456	138,389	442,764	390,260	22,254	30,250	.037	32,765,000
1932	189,707	[4] 29,104	63,130	[4] 281,941	[4] 248,917	21,747	11,277	.030	[4] 16,916,000
1933	165,791	[4] 12,307	85,578	[4] 263,676	[4] 249,713	7,677	6,286	.037	[4] 19,512,000
1934	186,468	22,744	102,024	311,236	299,841	10,241	1,154	.037	23,031,000
1935	192,544	35,233	96,783	324,560	310,505	13,659	396	.040	25,965,000
1936	239,944	47,462	111,750	399,156	387,698	11,401	57	.046	36,722,000

[1] The lead content of antimonial lead is excluded (see p. 176).
[2] Desilverized soft lead is excluded.
[3] Includes lead derived from Missouri ores and other nonargentiferous ores.
[4] Revised figures.

Source of primary lead.—Of the total refined lead produced in 1936, 97 percent was derived from domestic ores and 3 percent from foreign ores. Production from foreign ores decreased 17 percent in 1936. In 1928 more than 128,000 tons of foreign bullion were refined in the United States; in 1936 such refining virtually ceased. Details of the sources of lead derived from domestic ores are given in the section on Mine Production.

Refined primary lead produced in the United States, 1929–36, by sources, in short tons

Source	1929	1930	1931	1932	1933	1934	1935	1936
Domestic ore	672,498	573,740	390,260	[1] 248,917	[1] 249,713	299,841	310,505	387,698
Foreign ore:								
Australia	5	3		30		115		172
Canada	9,499	14,369	3,816	3,797	3,472	2,514	1,039	2,277
Europe	28	41	43	4,491	2,600	45	1,086	1,133
Mexico	16,807	14,949	6,420	334	257	1,011	5,809	1,486
South America	3,285	3,476	2,299	2,631	1,348	4,028	2,872	3,883
Other foreign	51	1,510	9,676	10,464		2,528	2,853	2,450
	29,675	34,348	22,254	21,747	7,677	10,241	13,659	11,401
Foreign base bullion:								
Mexico	51,295	18,592	30,072	11,164	6,021	703	396	57
South America	21,165	16,353	178	113	265	451		
	72,460	34,945	30,250	11,277	6,286	1,154	396	57
Total foreign	102,135	69,293	52,504	33,024	13,963	11,395	14,055	11,458
Grand total	774,633	643,033	442,764	[1] 281,941	[1] 263,676	311,236	324,560	399,156

[1] Revised figures.

Antimonial lead.—Antimonial lead or hard lead is an important byproduct of the refining of base bullion, but the amount derived from this source is only a small part of the country's yearly production. The major part is derived from the smelting of antimonial-lead scrap,

and some is produced by mixing metallic antimony with refined soft lead.

Several lead-smelting plants operate on scrap materials exclusively. Production data from such plants are summarized in the chapter on Secondary Metals. A large quantity of hard lead scrap also is treated at primary smelters and refineries, and the production of antimonial lead at these plants is shown in the table that follows.

Antimonial lead produced at primary lead refineries, 1929–36

Year	Production (short tons)				Antimony content		Lead content by difference (short tons)			
	From domestic ore	From foreign ore	From scrap	Total	Short tons	Percent	From domestic ore	From foreign ore	From scrap	Total
1929	17,062	8,607	17,575	43,244	4,935	11.4	(1)	(1)	(1)	38,309
1930	8,918	4,793	11,086	24,797	2,967	12.0	(1)	(1)	(1)	21,830
1931	(2)	(2)	(2)	21,842	2,438	11.2	3,628	1,603	14,173	19,404
1932	(2)	(2)	(2)	21,024	2,495	11.9	3,577	1,466	13,486	18,529
1933	(2)	(2)	(2)	17,805	1,720	9.7	4,158	791	11,136	16,085
1934	(2)	(2)	(2)	16,607	2,263	13.6	5,901	330	8,113	14,344
1935	(2)	(2)	(2)	16,384	1,729	10.6	4,685	491	9,479	14,655
1936	(2)	(2)	(2)	23,230	2,162	9.3	7,442	696	12,930	21,068

[1] Not recorded.
[2] Segregation discontinued.

SECONDARY LEAD

Recovery of secondary lead decreased 3 percent in 1936. Return of battery scrap for smelting and refining was 10 percent less than in 1935, and stocks of scrap were considerably lower at the end of the year. As the output of domestic refined primary lead was 25 percent higher, the ratio of secondary- to primary-lead production declined from the record high of 87 percent in 1935 to 68 percent in 1936. If lead consumption continues to increase, further declines in this ratio may be expected, as additional supplies of the metal will have to come largely from the mines. Further details on secondary-lead production in 1936 are given in the chapter on Secondary Metals.

Secondary lead recovered in the United States, 1929–36

[Compiled by J. P. Dunlop]

Year	Pig lead (short tons)—			Lead in alloys (short tons)	Total recovered lead		
	At primary plants	At secondary plants	Total		Short tons	Value	Ratio to domestic refined primary lead (percent)
1929	65,359	73,141	138,500	172,500	311,000	$39,186,000	46
1930	48,135	80,865	129,000	126,800	255,800	25,580,000	45
1931	43,774	85,026	128,800	105,900	234,700	17,367,800	60
1932	33,611	94,389	128,000	70,300	198,300	11,898,000	78
1933	41,632	90,168	131,800	92,700	224,500	16,613,000	86
1934	33,557	90,943	124,500	83,900	208,400	15,421,600	70
1935	44,748	112,052	156,800	113,600	270,400	21,632,000	87
1936	34,556	102,944	137,500	125,400	262,900	24,186,800	68

LEAD PIGMENTS

Lead pigments manufactured in 1936 contained 220,096 tons of lead, an increase of 11 percent over 1935. Of the 1936 total, 204,997 tons were derived from refined pig lead, of which white lead accounted for 44 percent, litharge 40 percent, red lead 15 percent, and sublimed lead and orange mineral 1 percent. Sublimed lead and leaded zinc oxide are the principal pigments in which the lead content is derived from ores.

Lead in pigments,[1] *1929–36, by sources, in short tons*

Year	Lead in pigments from—				Year	Lead in pigments from—			
	Domestic ore [2]	Metal	Scrap	Total		Domestic ore [2]	Metal	Scrap	Total
1929	9,429	248,657	2,427	260,513	1933	6,875	143,027	56	149,958
1930	6,686	190,182	689	197,557	1934	7,538	157,294	379	165,211
1931	5,722	166,328	710	172,760	1935	12,109	185,151	144	197,404
1932	4,932	127,318	262	132,512	1936	15,062	204,997	37	220,096

[1] Includes also lead recovered in zinc oxide and leaded zinc oxide.
[2] No pigments from foreign ore.

MINE PRODUCTION

Mine production of recoverable lead in 1936 was 373,986 tons, an increase of 13 percent over 1935; it was 44 percent below the average for 1925 to 1929. Missouri, Idaho, and Utah continued to be the principal sources and contributed 30, 24, and 19 percent, respectively, of the total production. Missouri's output (to which the Southeastern Missouri district contributed 108,422 tons), increased 13 percent over 1935, Idaho's 16 percent, and Utah's 10 percent. Production in the Tri-State district increased 11 percent and amounted to 10 percent of the 1936 total. Among the minor producers in the West, Montana, Arizona, and Colorado contributed larger tonnages in 1936 than in 1935. Production in Nevada and New Mexico was only slightly below that in 1935. Further details of production by mines, districts, and States can be found in the various State reports.

Mine production of recoverable lead in the United States, 1925–29 (average) and 1930–36, in short tons

State	1925–29 average	1930	1931	1932	1933	1934	1935	1936
Western States and Alaska:								
Alaska	982	1,365	1,661	1,261	1,157	840	670	[1] 941
Arizona	9,743	4,246	982	1,182	1,721	3,439	7,783	[1] 10,138
California	2,070	1,780	1,879	1,209	381	412	567	[1] 482
Colorado	30,112	22,130	6,884	2,150	2,402	4,218	5,673	7,267
Idaho	141,610	134,058	99,365	72,118	74,363	71,324	79,020	91,339
Montana	18,871	10,653	4,430	1,079	6,582	10,005	15,589	[1] 19,119
Nevada	9,807	11,529	7,930	440	2,303	10,991	12,676	[1] 12,305
New Mexico	6,730	10,378	11,269	10,114	11,043	9,365	7,289	6,626
Oregon	6	5	2	4	5	21	30	70
South Dakota	21	-------	-------	4	-------	-------	4	-------
Texas	213	198	-------	17	3	360	522	468
Utah	149,509	115,495	79,212	62,776	58,688	58,077	63,510	69,886
Washington	1,323	576	1,386	921	840	291	103	804
Wyoming	-------	-------	-------	5	-------	1	3	-------
	370,997	312,413	215,000	153,280	159,488	169,344	193,439	[1] 219,454
Central States:								
Arkansas	38	53	78	4	10	40	38	24
Illinois	552	248	205	31	240	40	436	294
Kansas	26,121	12,910	7,082	6,490	6,089	6,805	10,892	11,409
Kentucky	135	101	-------	-------	176	104	132	50
Missouri	202,240	199,632	160,121	117,159	84,980	90,493	97,493	110,428
Oklahoma	58,306	23,052	13,210	10,634	18,038	16,747	23,405	25,427
Wisconsin	1,745	1,537	952	910	540	234	286	904
	289,137	237,533	181,648	135,228	110,073	114,463	132,682	148,536
Eastern States:								
New York	-------	} 8,367						
Tennessee } Virginia	} 4,096		7,974	4,460	3,116	3,625	4,982	} 5,996
North Carolina	-------	-------	-------	-------	-------	-------	-------	
	4,096	8,367	7,974	4,460	3,116	3,625	4,982	5,996
	664,230	558,313	404,622	292,968	272,677	287,432	331,103	[1] 373,986

[1] Subject to revision.

Mine production of recoverable lead in the principal lead-producing districts of the United States, 1929–36, in short tons

District	State	1929	1930	1931	1932	1933	1934	1935	1936
Southeastern Missouri region.	Missouri	197,435	198,622	158,950	116,152	83,970	89,580	96,941	108,422
Coeur d'Alene region	Idaho	141,558	129,311	97,771	71,505	73,926	70,331	78,290	86,634
Bingham	Utah	49,447	42,586	33,597	32,640	33,030	32,420	36,293	32,451
Joplin region	Kansas, Missouri, Oklahoma.	74,143	36,972	21,463	18,131	25,137	24,465	34,849	38,842
Park City region	Utah	42,570	30,875	17,368	12,653	11,557	12,360	13,180	17,421
Butte	Montana	8,239	2,540	-------	1	4,185	5,391	10,302	(1)
Rush Valley	Utah	11,751	10,157	8,773	7,222	6,916	5,594	4,907	8,191
Tintic	do	44,113	29,474	18,427	9,842	6,433	5,715	5,833	7,063
Tybo	Nevada	1,991	3,622	4,083	-------	107	4,285	5,519	(1)
Willow Creek	New Mexico	5,720	5,431	7,563	6,449	7,075	6,143	5,162	3,746
Pioche	Nevada	2,986	4,868	2,892	74	1,626	4,644	4,955	(1)
Oro Blanco	Arizona	(2)	(2)	-------	-------	-------	1,676	4,717	(1)
San Juan Mountains	Colorado	17,386	11,722	908	792	906	1,651	2,428	3,279
Central	New Mexico	3,766	3,936	3,420	3,521	3,408	2,846	1,891	2,689
Ophir	Utah	25	18	13	2	87	1,349	2,392	3,862
Leadville	Colorado	5,172	6,808	1,470	76	505	524	1,288	1,550
Eagle	Montana	-------	1,287	3,489	771	1,521	2,560	1,121	(1)
Banner	Arizona	2,938	929	-------	-------	385	77	857	(1)
Jack Rabbit	Nevada	2,430	1,464	240	14	221	930	849	(1)
Inyo County	California	670	1,711	1,765	1,102	301	277	346	(1)
Upper Mississippi Valley	Iowa, northern Illinois, Wisconsin.	1,536	1,537	952	910	540	234	286	904
Bisbee (Warren)	Arizona	1,020	151	252	431	(2)	64	200	(1)
Pend d'Oreille	Idaho	863	956	1,020	576	309	318	189	562
Eagle County	Colorado	198	2,821	3,816	221	8	52	155	491
Warm Springs	Idaho	1,507	1,793	37	-------	21	8	32	2,757
Cedar Plains	Montana	1,177	120	25	2	1	2	7	(1)
Barker	do	6,137	4,578	21	-------	28	-------	22	(1)
Dome	Idaho	1,870	829	-------	1	-------	-------	-------	(2)
San Francisco	Utah	691	1,883	436	-------	-------	-------	42	60
Austinville [3]	Virginia	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Metaline [3]	Washington	328	267	1,257	682	722	237	(2)	770
St. Lawrence County [3]	New York	-------	(2)	(2)	(2)	(2)	(2)	(2)	(2)

[1] Data not yet available.
[2] Bureau of Mines not at liberty to publish figures.
[3] Not listed according to rank.

STOCKS

Lead stocks, as reported by the American Bureau of Metal Statistics, are shown in the following table. Stocks of refined and antimonial lead include metal held by all primary refiners and by most refiners of secondary material who produce common lead. Foreign lead refined in the United States and entered for domestic consumption is included.

Lead stocks at end of year at smelters and refineries in the United States, 1929–36, in short tons

	1929	1930	1931	1932	1933	1934	1935	1936
Refined pig lead	41,726	95,524	147,466	164,722	191,624	223,593	215,595	165,159
Antimonial lead	9,350	7,723	4,187	11,435	11,437	10,437	6,711	6,697
	51,076	103,247	151,653	176,157	203,061	234,030	222,306	171,856
Lead in base bullion:								
At smelters and refineries	8,313	8,171	12,952	13,911	12,786	6,045	15,072	9,187
In transit to refineries	7,116	4,261	2,971	1,302	2,191	1,528	1,860	1,070
In process at refineries	16,089	14,368	10,228	10,720	10,403	11,567	16,233	14,100
	31,518	26,800	26,151	25,933	25,380	19,140	33,165	24,357
Lead in ore and matte and in process at smelters	28,299	28,697	40,185	61,206	67,263	60,699	58,562	50,098
	110,893	158,744	217,989	263,296	295,704	313,869	314,033	246,311

Substantial progress was made in 1936 in liquidating the large stocks of refined lead accumulated from 1929 to 1934. The tonnage on hand at the close of the year was equivalent to about a 3-month supply at the average rate of domestic shipments during the last 4 months of 1936. Although stocks are considerably above normal, the large quantity of metal available for immediate delivery is strongly held and early in 1937 aided in preventing a run-away price situation when the speculative market reached its height.

Virtually no published data are available on stocks held outside of the United States. The British Metal Corporation, in its annual review of the lead industry issued in January 1937, stated that stocks were low (less than a 1.5-month supply). The extremely rapid rise in the London price precipitated by the speculative buying wave in the first few months of 1937 indicates that prompt supplies were far from plentiful.

DOMESTIC CONSUMPTION

New supply.—The following table shows the refined primary lead available for consumption from 1929 to 1936. The computation does not take into account variations in producers' stocks, and as these have changed considerably during the past 8 years the quantities shown do not indicate the true trend in the actual consumption of new lead. The supply available for consumption in 1936 was 20 percent greater than in 1935 but was equivalent to only 55 percent of the 1925–29 average. As total consumption of lead advanced 18 percent in 1936, it is evident that more of the increased demand was supplied by primary than by secondary metal.

Refined primary pig lead available for consumption in the United States, 1929 and 1931–36, in short tons

	1929	1931	1932	1933	1934	1935	1936
Supply:							
Stock in bonded warehouse Jan. 1	4,139	(1)	(1)	(1)	(1)	(1)	(1)
Imports	1,658	10	44	109	283	1,322	2,590
Production	774,633	442,764	288,361	273,579	311,236	324,560	399,156
	780,430	442,774	288,405	273,688	311,519	325,882	401,746
Withdrawn:							
Exports [2]	73,251	21,665	23,516	22,835	5,909	6,982	18,314
Stock in bonded warehouse Dec. 31	1,328	(1)	(1)	(1)	(1)	(1)	(1)
	74,579	21,665	23,516	22,835	5,909	6,982	18,314
Supply available for consumption	[3] 705,851	[3] 421,109	[3] 264,889	[3] 250,853	[3] 305,610	[3] 318,900	383,432

[1] Stocks of pigs, bars, etc., in bonded warehouse included with base bullion. (See table on p. 183.)
[2] Includes small quantities of foreign lead reexported.
[3] Revised figures.

Consumption by uses.—Owing to the large return of secondary lead from lead-consuming industries, the total consumption of pig lead greatly exceeds the supply of new lead available. The following table gives the American Bureau of Metal Statistics estimate of the total consumption of lead by industries, 1929–36.

Lead consumed in the United States,[1] 1929–36, in short tons

Purpose	1929	1930	1931	1932	1933	1934	1935	1936
White lead	119,700	83,900	77,500	54,500	59,100	64,500	80,000	85,500
Red lead and litharge	30,000	32,000	18,000	32,000	38,000	42,000	47,500	54,000
Storage batteries	210,000	163,000	157,000	138,000	147,000	163,000	175,000	191,000
Cable covering	220,000	208,000	117,000	55,500	31,400	35,200	38,900	61,400
Building	96,000	67,000	40,000	22,000	26,000	30,000	32,000	40,000
Automobiles	18,000	11,000	6,000	3,500	5,000	7,300	10,000	11,100
Railway equipment	5,700	5,200	1,000	300	200	1,100	500	2,400
Shipbuilding	300	500	400	200	100	200	200	200
Ammunition	41,100	33,300	29,700	23,300	32,300	34,800	29,200	32,500
Terneplate	4,200	2,700	2,200	1,400	2,500	2,600	4,700	6,200
Foil	39,800	26,000	20,000	14,000	22,500	16,200	15,900	28,500
Bearing metal	33,000	20,000	12,000	10,000	11,400	12,100	13,000	16,500
Solder	37,000	27,000	20,500	14,000	16,000	16,000	20,000	22,000
Type metal	18,000	16,000	14,400	10,800	11,000	13,000	15,000	17,000
Calking	31,500	21,000	15,000	10,000	12,000	10,000	12,000	13,500
Castings	18,000	12,000	7,000	5,000	5,000	5,000	5,000	5,750
Other uses	50,000	40,000	30,000	22,200	30,000	35,000	40,000	46,000
	972,300	768,600	567,700	416,700	449,500	488,000	538,900	633,550

[1] Source: American Bureau of Metal Statistics. These estimates are for the total consumption of lead irrespective of whether its origin be primary or secondary. Antimonial lead is included.

The total industrial use of lead increased 18 percent in 1936 but was still 35 percent below the 1929 record. All major uses increased in 1936 over 1935, and percentage gains for cable covering and building showed up exceptionally well. Compared with 1929, however, these two uses still lag far behind. The increased use of lead in foil was due partly to greater use of lead-tin foil in cigar wrappings, for which it is especially suitable because of its resistance to corrosion from the alkaloids in the tobacco. The added resistance to corrosion and strength of tellurium lead are increasing the use of this alloy.

To assist the consumer in obtaining lead products of standard quality, the Lead Industries Association has adopted a Seal of Approval, effective January 1, 1937. The seal is available to manufacturers whose products meet the standards set up by the association for lead pipe, lead traps, and bends.

PRICES

The two major markets for lead in the United States are New York and St. Louis; much of the lead produced in the United States is sold at prices based on quotations in these markets. The New York quotations are influenced to some extent by the lower prices usually prevailing on the London market, so that the New York price seldom exceeds the St. Louis price by as much as the freight differential, normally 0.35 cent a pound.

The New York quotation for lead in 1936 averaged 4.71 cents per pound, an increase of 16 percent over the 1935 average of 4.06 cents and 31 percent below the 1929 average of 6.83 cents. At the beginning of the year the price stood at 4.50 cents, where it remained until the latter part of February, when it was raised to 4.60 cents. Despite a substantial increase in stocks during the first 6 months and a subsequent decline following active buying in July, August, and September there was no further change in price until October, when domestic shipments approached predepression averages. From then until the close of the year the price was carried steadily upward by continued domestic consumption at high levels, threatened shortage of supplies by shut-downs due to strikes at some mines in the West, and the boom market in London. On December 31 the price was 6. 03 cents, the highest since February 1930.

Average monthly and yearly quoted prices of lead at St. Louis, New York, and London, 1934-36, in cents per pound [1]

Month	1934			1935			1936		
	St. Louis	New York	London	St. Louis	New York	London	St. Louis	New York	London
January	3. 90	4. 00	2. 55	3. 54	3. 69	2. 25	4. 35	4. 50	3. 41
February	3. 90	4. 00	2. 61	3. 38	3. 53	2. 22	4. 37	4. 52	3. 58
March	3. 90	4. 00	2. 63	3. 43	3. 58	2. 35	4. 45	4. 60	3. 69
April	4. 05	4. 18	2. 65	3. 54	3. 69	2. 64	4. 45	4. 60	3. 55
May	3. 99	4. 14	2. 52	3. 81	3. 96	3. 02	4. 45	4. 60	3. 45
June	3. 82	3. 98	2. 49	3. 87	4. 02	3. 03	4. 45	4. 60	3. 40
July	3. 63	3. 77	2. 43	3. 97	4. 12	3. 20	4. 45	4. 60	3. 55
August	3. 60	3. 75	2. 45	4. 10	4. 25	3. 50	4. 45	4. 60	3. 76
September	3. 54	3. 69	2. 32	4. 26	4. 41	3. 58	4. 45	4. 60	4. 05
October	3. 51	3. 66	2. 28	4. 36	4. 51	3. 99	4. 49	4. 65	4. 03
November	3. 42	3. 57	2. 32	4. 35	4. 50	3. 94	4. 96	5. 14	4. 74
December	3. 45	3. 60	2. 28	4. 35	4. 50	3. 70	5. 40	5. 57	5. 60
Average	3. 73	3. 86	[2] 2. 46	3. 91	4. 06	[2] 3. 12	4. 56	4. 71	[2] 3. 91

[1] St. Louis: Metal Statistics, 1937, p. 399. Average daily quotations of soft Missouri lead, f. o. b. St. Louis (open market), as reported daily in the American Metal Market.
New York: American Metal Market, daily issues. Pig lead, New York (outside market), prompt shipment from West.
London: Metal Statistics, 1937, p. 403. Average price of foreign lead. Price per long ton, as published in Metal Statistics, converted to cents per pound at average exchange rate reported by the Federal Reserve Board.

[2] London quotations in pounds sterling per long ton, as follows: 1933, £11.6708; 1934, £10.9333; 1935, £14.2375; 1936, £17.6000.

The London quotation for 1936 (United States exchange basis) averaged 3.91 cents per pound, the highest since 1930. The differential between New York and London in 1936 averaged 0.80 cent per pound in favor of New York. During the latter half of the year, however, the price advance in London was more pronounced than in New York owing to a more favorable stock position abroad, cessation of supplies from Spain caused by the civil war, and threatened curtail-

ment elsewhere on account of labor troubles. In consequence, London set the pace in the upward swing, and by December the London quotation actually exceeded the New York. At times the differential in favor of London was high enough to make exportation from the United States profitable. On December 31, the London quotation was equivalent to 6.21 cents per pound, compared to 6.03 cents at New York.

FOREIGN TRADE[3]

The foreign trade of the United States in lead consists largely of imports of ore and base bullion, which are smelted and refined in bond, and the export of this lead either as refined lead or in manufactured products. Since 1927, however, this trade has declined. In 1936 only 23,615 short tons of lead in ore, base bullion, and refined and scrap lead were imported, compared with 161,389 tons in 1927; exports of refined lead decreased from 125,267 to 18,314 tons. During the same period lead exported in manufactures with benefit of drawback declined from 12,004 to 7,735 tons.

Imports.—Total imports of lead in ore and matte, including imports for immediate consumption and entries for warehouse, increased slightly. Larger receipts from Mexico, Canada, and Peru were offset by smaller shipments from Newfoundland and Chile. Imports of base bullion virtually ceased, but imports of refined lead, which for several years were only a few hundred tons, increased to 2,590 tons in 1936. Total imports of lead decreased 2 percent and were only 20 percent of the 1929 total.

Total lead imported into the United States, 1930–36, by classes, in short tons [1]

Year	Lead in ore and matte	Lead in base bullion	Pigs, bars, sheets, and old	Total lead content
1930	39,377	38,630	209	78,216
1931	20,888	32,320	[2] 10	53,218
1932	21,001	13,462	44	34,507
1933	5,958	1,587	109	7,654
1934	10,611	2,450	283	13,344
1935	20,025	2,692	1,322	24,039
1936	20,713	312	2,590	23,615

[1] Data for 1934-36 include lead imported for immediate consumption plus material entering the country under bond, as do figures for earlier years.
[2] Reclaimed scrap, etc. No imports of pigs, bars, etc., were recorded for 1931.

Total lead imported into the United States, in ore, base bullion, and refined, 1930–36, by countries, in short tons [1]

Year	Canada	Mexico	Newfoundland	South America	Europe	Other countries	Total
1930	17,268	36,721		22,472	113	1,642	78,216
1931	2,618	38,706	9,708	2,171		15	53,218
1932	2,459	13,545	10,598	2,811	5,053	41	34,507
1933	1,629	2,154		1,485	2,368	18	7,654
1934	1,160	3,270	3,357	5,455	67	35	13,344
1935	236	9,786	6,837	6,643	512	25	24,039
1936	1,692	10,501	3,955	6,861	341	265	23,615

[1] Data for 1934-36 include lead imported for immediate consumption plus material entering the country under bond, as do figures for earlier years.

[3] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Total lead imported into the United States, in ore and matte, 1930–36, by countries, in short tons [1]

Country	1930	1931	1932	1933	1934	1935	1936
Canada	17,257	2,614	2,459	1,629	902	58	1,419
Chile	3,313	1,866	2,211	651	1,443	1,102	574
Mexico	16,341	6,495	195	862	1,283	7,986	10,462
Newfoundland	--------	9,708	10,598	--------	3,357	6,818	3,955
Peru	831	194	477	522	3,545	3,716	4,007
Sweden	--------	--------	5,024	2,292	--------	--------	--------
Other countries	1,635	11	37	2	81	345	296
	39,377	20,888	21,001	5,958	10,611	20,025	20,713

[1] Data for 1934–36 include lead in ore and matte imported for immediate consumption plus material entering the country under bond, as do figures for earlier years.

Total lead imported into the United States, in base bullion, 1930–36, by countries, in short tons [1]

Country	1930	1931	1932	1933	1934	1935	1936
Mexico	20,350	32,210	13,340	1,281	1,987	1,746	39
Peru	18,280	110	121	306	463	784	52
Other countries	---------	---------	1	---------	---------	162	221
	38,630	32,320	13,462	1,587	2,450	2,692	312

[1] Data for 1934–36 include lead in base bullion imported for immediate consumption plus material entering the country under bond, as do figures for earlier years.

Lead remaining in warehouses in the United States, Dec. 31, 1930–36, in short tons

[Stated in the form in which the material was entered for warehouse]

Year	Lead in ore and matte	Lead in base bullion [1]	Year	Lead in ore and matte	Lead in base bullion [1]
1930	39,516	5,642	1934	15,709	606
1931	52,849	5,343	1935	22,598	2,173
1932	42,314	3,769	1936	33,401	1,930
1933	21,540	1,058			

[1] Pigs, bars, sheets, and old included with base bullion.

Lead imported for consumption in the United States, 1930–36, by classes

Year	Lead in ore and matte [1]		Lead in base bullion		Pigs, bars, and old		Sheets, pipe, and shot		Not otherwise specified	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1930	15,458	$1,461,350	10,423	$1,127,920	571	$60,493	454	$78,737	$87,612	$2,816,112
1931	10,734	1,194,191	10,436	671,002	[2] 10	[2] 1,763	428	60,536	49,990	1,977,482
1932	9,647	863,135	2,574	131,579	44	2,031	543	53,510	14,848	1,065,103
1933	19,239	1,154,093	306	31,700	45	2,199	518	45,378	13,578	1,246,948
1934	10,760	558,558	2,220	117,729	[2] 285	[2] 10,678	286	35,130	12,940	735,035
1935	8,273	258,954	1,154	66,559	1,590	99,799	404	51,979	12,484	489,775
1936	5,836	225,568	763	45,340	2,320	121,148	304	38,546	12,729	443,331

[1] Classification as follows: Jan. 1, 1929, to June 17, 1930, "Lead in ore and matte"; June 18, 1930, through 1936, "Lead in ores, flue dust, and mattes, n. s. p. f."
[2] Reclaimed scrap, etc. No imports of pigs, bars, etc., recorded for 1931 and 1934.

Miscellaneous products containing lead imported for consumption in the United States, 1930–36

Year	Babbitt metal, solder, white metal, and other combinations containing lead			Type metal and antimonial lead		
	Gross weight (short tons)	Lead content (short tons)	Value	Gross weight (short tons)	Lead content (short tons)	Value
1930	1,399	530	$593,103	328	275	$32,934
1931	906	310	436,574			
1932	498	191	143,662	6	5	479
1933	349	51	30,623	25	21	1,076
1934	709	102	71,505	112	94	6,784
1935	128	24	44,269	534	445	36,453
1936	334	67	112,205	456	400	34,694

Exports.—Exports of refined lead nearly trebled in 1936, and Mexico and Japan imported virtually the entire increase. Exports credited to Mexico, however, probably represent shipments destined for other countries. Very little, if any, of the lead exported in 1936 was domestic metal.

Refined lead [1] exported from the United States, 1930–36

Year	Pigs, bars, and old		Foreign lead exported in manufactures with benefit of drawback (short tons)	Year	Pigs, bars, and old		Foreign lead exported in manufactures with benefit of drawback (short tons)
	Short tons	Value			Short tons	Value	
1930	48,307	$3,904,213	12,161	1934	5,909	$305,994	7,472
1931	21,665	1,241,881	10,503	1935	6,982	472,017	8,995
1932	23,516	1,069,697	7,220	1936	18,314	1,390,632	7,735
1933	22,835	834,589	6,508				

[1] Includes small quantities of foreign lead reexported.

Refined pig lead [1] exported from the United States, 1930–36, by destinations, in short tons

Destination	1930	1931	1932	1933	1934	1935	1936
COUNTRY							
Argentina	934	226		113	(2)		3
Brazil	874	1,382	759	329	475	338	795
Canada	9	58	132	6	21	45	44
France	3,001	318	224				
Germany	823	52	1,344	5		11	2
Japan	15,653	17,301	20,219	21,236	4,454	5,324	8,628
Mexico	40	171	13	5	21	38	8,049
Netherlands	22	13	112		4	188	
Philippine Islands	543	400	475	360	169	217	223
Sweden	7,557	392					5
United Kingdom	9,157	3	(2)		36	8	123
Uruguay	364	145	84	140	221	112	
Other	9,330	1,204	154	641	508	701	442
	48,307	21,665	23,516	22,835	5,909	6,982	18,314
CONTINENT							
North America	318	435	155	41	107	157	8,283
South America	2,442	1,903	868	736	1,076	668	1,021
Europe	27,899	795	1,793	5	40	212	133
Asia	17,289	18,524	20,700	22,053	4,684	5,945	8,865
Africa and Oceania	359	8			2	(2)	12
	48,307	21,665	23,516	22,835	5,909	6,982	18,314

[1] Includes small quantities of foreign lead reexported.
[2] Less than 1 ton.

TECHNOLOGY

Mining.—The lead industry advanced rapidly in the use of mechanical loading equipment. The mines of the Southeastern Missouri district are now virtually on a 100-percent mechanized basis, and many lead and lead-zinc mines in the Eastern and Western States are equipped with mechanical shovels and scrapers. A survey recently conducted by the Bureau of Mines[3] indicates that there is much interest in mechanical loading and that such equipment has a large potential use.

Stope filling by means of a free-flowing mud dropped from the surface through raises has been adopted at the Sullivan mine in British Columbia. Excess water is drained off the bottom of the stope. The mud is expected to set sufficiently to permit easy mining of adjacent pillars.

Milling.—A total of 335,889 short tons of lead flotation concentrates was produced in the United States in 1936 (exclusive of the Tri-State and Wisconsin districts), according to the American Bureau of Metal Statistics. The average lead content was 59.28 percent compared with 60.19 percent in 1935 and 54.81 percent in 1929. According to Pallanch,[4] modern flotation practice is governed largely by economic considerations and frequently high-grade metallurgical results are not justified under conditions imposed by smelter contracts, freight rates, and prices.

A new edition of Flotation Plant Practice by P. Rabone was published in 1936.

Smelting.—Of outstanding interest is the new volume on Metallurgy of Lead and Zinc issued early in 1937 as volume 121, Transactions of the American Institute of Mining and Metallurgical Engineers. The book presents a complete summary of the present status of lead metallurgy.

In reviewing the progress of lead metallurgy in 1936, Hayward[5] points out that increasing supplies of precious-metal concentrates at some plants have so reduced the lead content of the charge that some bullion has to be recirculated to collect the precious metals. The advantages of a larger number of tuyères with smaller diameter, as demonstrated at Trail, British Columbia, have resulted in their use at other plants.

A unique process for the simultaneous production of lead and sulphur by electrolysis of galena is being tested in North Wales. In a semi-commercial plant 300 tons of lead 99.95 percent pure and 40 tons of sulphur 99.5 percent pure have been produced. The operation is conducted in what is described as a "fused chloro-sulphide melt." The principal advantage claimed for the process over smelting is that it eliminates the sulphur-disposal problem.[6]

Processes used in the recovery of lead from battery scrap and residues were described by Thews in the January 1937 issue of Canadian Chemistry and Metallurgy.

WORLD ASPECTS OF LEAD INDUSTRY

International cooperation.—The informal agreement of July 1935, under which certain producers agreed not to increase production

---

[3] Plein, L. N., Berquist, F. E., and Tryon, F. G., Mechanical Loading Underground: Eng. and Min. Jour., vol. 138, no. 5, 1937, p. 241.

[4] Pallanch, R. A., Factors Governing the Separation of Lead and Zinc in Ore by Flotation: Min. and Met., vol. 17, no. 356, 1936, pp. 386–389.

[5] Hayward, Carle R., Metallurgy of Lead: Min. and Met., vol. 18, no. 361, January 1937, p. 18.

[6] Chemical Engineering and Mining Review, vol. 29, no. 341, Feb. 8, 1937, p. 195.

without due notice to each other, apparently was continued in 1936. The latter part of the year the Lead Industries Development Council, an organization of British producers, established a Technical Information Bureau in London to promote the use of lead.

World production.—World smelter production of lead increased 6 percent in 1936 and was equivalent to 82 percent of the record output in 1929. Production increased 23 percent over 1935 in the United States and 1 percent elsewhere. The domestic output constituted only 57 percent of the 1929 total, whereas that of the rest of the world was 97 percent. The United States continued as the leading producer and contributed 25 percent of the 1936 total. The 10 other leading producing countries and the proportion of the world total each contributed in 1936 were as follows: Mexico 15 percent, Australia 13, Canada 11, Germany 10, India (Burma) 5, Belgium 5, U. S. S. R. (Russia) 3, Spain 3, Italy 3, and Tunisia 1. Of these, Australia, Spain, and Tunisia experienced substantial declines, whereas Mexico, Canada, Germany, and the U. S. S. R. (Russia) made notable increases. India and Belgium increased their production slightly in 1936, and Italy reduced her output moderately. Among the minor producers, the United Kingdom declined sharply, and Peru, Japan, and France increased their output appreciably. Production in the British Empire was about 450,000 metric tons in 1936, a decrease of 4 percent from 1935. The Empire share of world output was 31 percent in 1936 compared with 22 percent for the 5-year period, 1925–29.

World production of lead, 1929 and 1931–36, in metric tons [1]

[Compiled by R. B. Miller]

Country	1929	1931	1932	1933	1934	1935	1936
Argentina	9,020	7,609	3,481	2,799	5,047	4,103	(2)
Australia	180,358	152,850	189,347	208,558	199,151	221,431	196,712
Austria	6,569	6,117	1,986	4,626	5,629	8,048	8,732
Belgium	82,850	70,850	64,160	69,390	74,750	68,980	69,200
Canada	138,095	126,301	114,820	115,469	142,635	153,808	164,857
China	2,190	2,500	2,728	3,844	1,665	(2)	(2)
Chosen	333	97	453	784	1,806	1,728	(2)
Czechoslovakia	4,609	3,569	4,124	3,811	4,066	4,805	(2)
France	20,358	19,100	19,600	20,400	17,867	5,600	7,200
Germany [3]	97,900	101,300	95,216	116,600	119,980	122,300	144,762
Greece	5,361	6,707	6,482	8,205	8,899	6,422	(2)
Hungary	109	52	----------	11	42	14	26
India (Burma)	81,521	75,985	72,345	73,201	72,968	73,217	74,329
Indochina	17	6	16	18	15	18	(2)
Italy	22,650	24,882	31,471	24,756	47,843	42,551	40,500
Japan	3,374	4,070	6,415	6,825	7,039	7,442	8,021
Mexico	239,952	210,427	132,890	118,460	165,416	178,923	214,376
Northern Rhodesia	1,661	----------	----------	75	187	185	305
Norway	[4] 300	347	435	365	333	577	(2)
Peru	19,448	252	327	497	1,998	6,452	8,817
Poland	35,789	31,380	11,902	12,065	10,350	18,819	15,021
Portugal	96	108	109	70	54	----------	(2)
Rumania	565	1,314	1,938	4,082	4,382	4,557	(2)
South-West Africa [5]	2,802	2,641	1,044	408	----------	----------	----------
Spain	142,753	109,630	105,370	88,354	72,151	70,823	46,600
Tunisia	18,850	19,112	14,082	14,873	27,311	25,388	20,350
Turkey	7,324	2,767	----------	----------	----------	----------	(2)
U. S. S. R. (Russia)	[6] 6,200	15,494	18,717	13,671	27,184	44,853	50,800
United Kingdom	10,839	10,723	7,100	5,600	9,100	22,350	13,747
United States (refined) [7]	636,997	374,224	245,541	233.499	281,300	294,075	362,055
Yugoslavia	9,471	7,929	8,321	6,336	9,803	7,948	5,804
	1,788,000	1,388,000	1,160,000	1,158,000	1,319,000	1,395,000	1,475,000

[1] By countries where smelted but not necessarily refined.
[2] Data not available. Estimate included in total.
[3] Exclusive of secondary material (Metallgesellschaft, Frankfurt).
[4] Approximate production.
[5] Year ended Mar. 31 of year following that stated.
[6] Year ended Sept. 30.
[7] Figures cover lead refined from domestic and foreign ore; refined lead produced from foreign base bullion not included.

World consumption.—The American Bureau of Metal Statistics reports world consumption of lead in 1936 as 1,596,700 metric tons, an increase of 12 percent over 1935 and equivalent to 95 percent of the 1929 record. The increase in the United States over 1935, after allowance is made for changes in stocks and including secondary and antimonial lead produced at primary refineries, was 26 percent compared with 7 percent elsewhere. Compared with predepression levels, however, foreign consumption was relatively much higher, as it actually exceeded the 1929 total 12 percent, whereas the United States used 33 percent less. According to the American Bureau of Metal Statistics Spain was the only important consumer that used less lead in 1936 than in 1935, but later information indicates that apparent consumption in Italy declined about 33 percent owing to a decrease in imports, which were exceptionally high during the latter part of 1935. Since much of the lead imported in 1935 probably was used in 1936, actual consumption in 1936 may have been higher than that in 1935. Other important lead-consuming countries showed percentage increases as follows: United Kingdom 6, Germany 20, Japan 8, France 2, U. S. S. R. (Russia) 19, and Belgium 12. The United States, which used 28 percent of the total quantity of lead consumed in 1936, again ranked first in consumption. The other leading consumers and the percentage of the total each absorbed in 1936 were as follows: United Kingdom 22, Germany 13, Japan 7, France 6, U. S. S. R. (Russia) 5, Italy 4, and Belgium 3.

REVIEW BY COUNTRIES

Australia.—The 11-percent decrease in smelter output in 1936 was due to a decline in production of lead at Port Pirie. The 1935 output at this plant was unusually large owing to the smelting of stocks of ore accumulated in previous years.

Crude ore raised from the Broken Hill mines in 1936 totaled 1,350,000 long tons, an increase of 42,700 tons over 1935. Production of lead concentrates increased from 243,800 long tons in 1935 to 256,000 in 1936. In addition to the four principal producers, Broken Hill Proprietary Co., Ltd., resumed operations in March after a shutdown of several years. The British section of the North mine was put into operation in August. A new treatment plant, with a monthly capacity of 50,000 tons of ore, will be installed at the North mine.

Output of lead bullion from Mt. Isa increased from 33,100 tons in 1935 to 35,382 tons in 1936. During the year an application was made to the Commonwealth for a concession to build a railway from Mt. Isa to the Gulf of Carpentaria, thereby reducing the rail haulage from 603 miles to 200 or 300 miles.

The new smelting plant of Wiluna Gold Mines, Ltd., at Wiluna, Western Australia, for the treatment of antimonial-lead flotation concentrates, made its first run on October 2. The plant has been described by Ling.[7]

Exports of pig lead from Australia declined from 189,000 tons in 1935 to 176,000 tons in 1936, and shipments of ore and concentrates increased from 18,000 to 31,000 tons. Both metal and ore are sold chiefly in the European market.

[7] Ling, E. S., Wiluna Gold Mines Smelting Plant; Canadian Min. Jour., vol. 58, no. 5, 1937, pp. 235–240.

Belgium.—Refined lead production in Belgium is derived from foreign ores and base bullion. In 1936, 99,900 metric tons of lead ores and 35,200 tons of pig lead were imported. Yugoslavia, Sweden, Canada, South America, and Australia were the principal sources of the ore, and Mexico supplied most of the pig lead. Imports of ore were 17 percent more than in 1935 and imports of metal 55 percent more. About 57,000 tons of pig lead and 8,000 tons of lead in sheets, pipe, etc., were exported in 1936.

Canada.—Mine production of lead in Canada in 1936 was 191,400 short tons, an increase of 13 percent over 1935. British Columbia produced 98 percent of the total, with Yukon and Northwest Territories, Quebec, and Nova Scotia contributing about 1,000 tons each. At the Sullivan mine of the Consolidated Mining & Smelting Co., Ltd., the principal producer in British Columbia, the concentrator treated 1,901,000 short tons of ore which yielded 253,154 short tons of lead concentrates; 227,000 tons were produced in 1935. Production at the Trail smelter, the only active lead smelter in Canada, reached an all-time high and costs an all-time low. Lead recoveries were slightly lower than in 1935. The Tetreault mine in Quebec made the entire output from that Province, the Stirling mine that from Nova Scotia, and the Mayo camp that from Yukon.

Exports of refined pig lead amounted to 161,000 short tons compared with 141,000 tons in 1935; the United Kingdom took 100,000 tons and Japan 49,000 tons of the 1936 total. Shipments to the United Kingdom were 7 percent higher and those to Japan 42 percent higher than in 1935. Exports of lead in ore dropped from 5,700 to 4,700 short tons.

France.—France ranks fifth in lead consumption and depends largely on foreign lead for its supply. Consumption was 93,100 metric tons in 1936, an increase of 2 percent over 1935. Imports of refined pig lead declined from 82,000 metric tons in 1935 to 79,500 tons in 1936. In addition, 6,100 metric tons of bullion were imported in 1936 compared to 3,600 tons in 1935. The principal sources of refined and crude lead in 1936 were Spain, 26 percent; Belgium and Tunisia, 23 percent each; and Mexico, 20 percent. More than 40,000 metric tons of lead ore were imported in 1936 compared with 7,000 tons in 1935, and 9,600 tons were exported. Other lead exports were relatively unimportant.

In October the French Government suspended subsidies to lead mines, owing to the substantial rise in prices. Operation of the Pennarroya smelter at Noyelles-Godault was begun in October. Its initial capacity is stated to be 40,000 metric tons of metal a year, and an increase to 60,000 tons is contemplated.

Germany.—Consumption of lead in Germany increased from 172,000 metric tons in 1935 to 207,000 in 1936; most of the increase was due to the rise in smelter output. Imports of pig lead were 69,000 tons, of which Mexico supplied 40,000 tons. Exports declined from 4,000 tons in 1935 to 1,000 in 1936. Imports of lead ore amounted to 99,000 tons compared with 84,000 in 1935. Newfoundland, Yugoslavia, South America, Australia, and the United Kingdom were the principal sources. Apparently domestic mines supplied only 60 percent of the smelter output in 1936. Lead mining is conducted under Government subsidy, and the use of lead is rigidly restricted by Government rulings.

Greece.—The Compagnie Française du Laurium produced 4,172 metric tons of lead in 1936 compared with 4,692 tons in 1935.

India, British.—The Burma Corporation, Ltd., produced 104,280 long tons of lead concentrates containing 66 percent lead and 46 ounces of silver per ton compared with 106,000 long tons containing about 65 percent lead and 43 ounces of silver per ton in 1935. The output of refined lead was 71,915 long tons compared with 70,560 tons in 1935; 1,240 long tons of antimonial lead were also produced. Exports of refined and antimonial lead totaled 70,000 long tons, of which the United Kingdom took 47,000 and Japan 12,000 tons.

Italy.—Although lead production has increased at Italian mines in recent years, Italy still depends on foreign lead to a considerable extent. Production of lead concentrates totaled 49,875 metric tons in 1936, imports 21,571 tons, and exports 4,600 tons, indicating a net consumption of 66,846 tons for the year. Thus, net imports accounted for 25 percent of the total lead consumed. Production of metal amounted to 40,500 metric tons, and net imports were 8,000 tons which was 16 percent of the apparent consumption of 48,500 tons. Since 25 percent of the smelted product was derived from imported ores, it follows that foreign materials accounted for 37 percent of Italy's lead consumption in 1936. Consumption of lead in 1935, which was exceptionally high, amounted to 72,628 tons—derived from a domestic production of 42,551 tons and net imports of 30,077 tons. Import duties are 170 lire a ton for lead ores and 450 lire a ton for pig lead.

Japan.—In 1936 Japan imported 95,900 metric tons of lead, an increase of 6 percent over 1935. Of the 1936 total, Canada was credited with 43,500 tons, British India with 13,000, the United States with 9,400, and other countries (probably mostly Mexico) with 30,000. The Anshan smelter, which began production in the latter part of 1935, is expected to supply a large part of Japan's lead requirements, although large-scale production apparently has not been achieved as yet.

Mexico.—Production of refined lead increased 20 percent in 1936. Operation of the smelter at San Luis Potosi was discontinued during the latter part of the year because of a strike which lasted 3 months. The decline in output at this plant, however, was offset by increased production at other plants. Refineries worked at 50 percent of capacity in 1936. Exports of lead amounted to 210,000 metric tons compared with 205,000 tons in 1935. Most of the lead exported from Mexico goes to Europe, but Japan has been a heavy buyer of Mexican lead in recent years. Exports of lead bullion to the United States for refining virtually ceased in 1936, but ore containing approximately 9,500 metric tons of lead was shipped to this country.

Newfoundland.—Production of lead concentrates in 1936 totaled 46,000 short tons compared with 48,100 tons in 1935. About 6,000 tons were exported to the United States in 1936, and the balance went to Europe.

Peru.—Early in 1937 the export tax on lead and zinc, which had been suspended for a considerable period, was reestablished. Cerro de Pasco is enlarging the capacity of its lead smelter at Oroya to 40,000 metric tons of refined lead per annum.

Spain.—The civil war disrupted the Spanish lead industry in 1936. Production has been estimated at 46,500 metric tons, a decline of about 35 percent from 1935. The annual output has declined steadily since 1929, and the 1936 output amounted to only one-third of the 1929 production.

U. S. S. R. (Russia).—Consumption has been estimated at 80,000 metric tons in 1936, of which approximately 30,000 tons were imported. Discovery of a large lead deposit in the Lake Balkhash region was reported in 1936.

United Kingdom.—Apparent consumption of pig lead exceeded all previous records in 1936 when 346,000 long tons were used. Production of pig lead declined, but imports increased from 316,000 tons in 1935 to 356,000 tons in 1936. Australia supplied 49 percent, Canada 25 percent, and India 14 percent of the 1936 imports. The British Metal Corporation, Ltd., estimates that 63 percent of the lead consumed in the United Kingdom is used in sheet, pipe, white lead, and oxide, 21 percent in cable, 6 percent in storage batteries, and 10 percent in miscellaneous products.

Mill Close Mines, Ltd., the largest producer in the United Kingdom, produced 10,000 tons less in 1936 owing to a fall in the grade of ore. Experiments are being conducted with a view to recovering by flotation the metal content of fines discharged from the mill. Attempts to revive lead mining in several of the old districts are being continued.

The Lead Industries Development Council, an organization of British lead producers, established a Technical Information Bureau in 1936, the object of which is to develop new uses and to improve old uses of lead. The Bureau will also endeavor to encourage standardization of lead products.

Yugoslavia.—Trepca Mines, Ltd., the largest producer of lead in Yugoslavia, treated 600,200 metric tons of ore, from which were obtained 65,700 tons of 80 percent lead concentrates containing nearly 27 ounces of silver per ton and 78,100 tons of 50-percent zinc concentrates. Exports of lead ore decreased from 74,900 metric tons in 1935 to 55,700 tons in 1936. Belgium continued to be the leading importer, taking over 35,000 tons, and Italy ranked second with 11,000 tons. Zletovo Mines, Ltd., with a reserve of nearly 1,000,000 tons of ore containing 11.5 percent lead, 3.5 ounces of silver per ton, and 1.7 percent zinc, is planning to erect a plant to treat 110,000 tons of ore annually for the recovery of lead and silver. Kapaonik Mines is to be brought into production in 1937. The ore will be treated at the Trepca mill.

ZINC[1]

By Elmer W. Pehrson

SUMMARY OUTLINE

The zinc industry of the United States enjoyed its fourth consecutive year of recovery in 1936. Production, consumption, and price all increased decidedly over the 1935 figures, and stocks on hand at smelters at the close of the year were the lowest since 1928. In consequence of all these factors, zinc producers experienced their best year since 1929.

The St. Louis quotation for prime western zinc fluctuated between a low of 4.75 cents per pound established in July and a high of 5.45 cents at the close of the year. The average was 4.90 cents compared with 4.33 cents in 1935, but the increase was due more to the maintenance of levels attained during the latter part of 1935 than to the higher levels recorded during the last month and a half of 1936. From January to November quotations moved between the narrow limits of 4.75 and 4.90 cents. The statistical position during this period undoubtedly justified higher prices, but the unfavorable London market established a definite ceiling for domestic quotations. From January to November London prices were 2 cents per pound below the New York market. In view of the United States tariff of 1¾ cents, this situation constantly threatened producers with the loss of domestic markets to foreign metal, imports of which increased to 11,660 tons, the highest amount recorded since the beginning of the century. This situation was relieved, however, by the tremendous buying wave in Europe, which began in the latter part of the year and continued into 1937. In March 1937 London prices actually exceeded domestic quotations.

[1] This report deals primarily with the smelting branch of the industry. Full details of zinc mining are given in the various State reports. Some zinc ore is used directly in the manufacture of zinc pigments. (See chapter on Lead and Zinc Pigments and Zinc Salts.)

Improvement in industry frequently is measured in terms of price, but it should be remembered that to a large extent price merely reflects the balance between production and consumption. Since there has been no dearth of zinc production in recent years, the increase in consumption has been the significant factor in the recovery experienced by this industry. In 1936 consumption of zinc of all kinds, except rolled zinc, increased substantially. Production of rolled products was satisfactory, and the slight decline in 1936 was due largely to a recession in the use of glass-jar tops, for which there was an unusual demand in 1935. Galvanizing, the principal use of zinc, increased 24 percent over 1935, and the use of zinc in brass was 35 percent greater, due in part to the record sales of brass pipe for water lines. Die castings took 30 percent more zinc in 1936 than in 1935 and the quantity used for this purpose in 1936 was twice

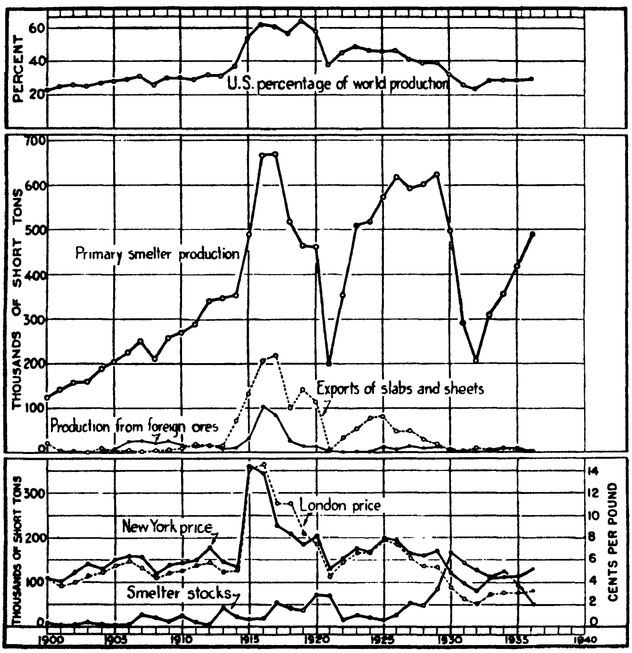


FIGURE 29.—Trends in the zinc industry in the United States, 1900–1936. Imports of slab and sheet zinc are not shown, as they seldom exceed 500 tons annually. In the last few years, however, they have increased, and in 1936 amounted to 11,900 tons.

that so used in 1929. Consumption of primary and secondary slab zinc was only 8 percent below the peak established in 1929.

Outside the United States production and consumption rose to higher levels although, as previously mentioned, the price situation was not satisfactory. During most of 1936 supplies exceeded demand, a situation that prompted British and Belgian producers to attempt reformation of the cartel. British participation was offered on the basis of preferential treatment for producers in the United Kingdom in their home markets. With Germany and Italy striving for self-sufficiency and France experimenting with higher tariffs, agreement on restriction of output was impossible. This forced producers in the United Kingdom to ask the Government for increased tariff protec-

tion. However, with the rapid rise in price and the shortage of supplies that developed during the latter part of the year, questions concerning cartel and tariff policies became relatively unimportant, and no action was taken up to the close of the year.

Salient statistics of the zinc industry in the United States, 1925–29 (average) and 1931–36

	1925–29 average	1931	1932	1933	1934	1935	1936
Production of primary slab zinc:							
From domestic ores......short tons..	589,648	291,996	207,148	306,010	355,366	412,184	491,803
From foreign ores..............do....	12,734	....	....	1,172	8,224	8,450	329
	602,382	291,996	207,148	307,182	363,590	420,634	492,132
Electrolytic.........percent of total..	21	28	11	29	21	28	26
Distilled.....................do....	79	72	89	71	79	72	74
Production of secondary slab zinc short tons..	65,380	34,800	20,000	48,100	29,300	55,400	68,000
Stocks on hand at primary smelters Dec. 31...................short tons..	45,575	143,592	128,192	110,487	124,783	90,539	55,500
Primary zinc available for consumption do....	[1] 548,472	[1] 315,328	[1] 216,387	[1] 325,632	[1] 345,914	[1] 457,705	538,794
Price—prime western at St. Louis:							
Average for year..cents per pound..	6.76	3.64	2.88	4.03	4.16	4.33	4.90
Highest quotation.............do....	8.90	4.12½	3.50	5.00	4.40	4.95	5.45
Lowest quotation..............do....	5.40	3.12½	2.30	2.55	3.67½	3.70	4.75
Price—yearly average at London.do....	6.46	2.52	2.12	2.96	3.07	3.08	3.31
Mine production of recoverable zinc short tons..	724,720	410,318	285,231	384,280	438,726	517,903	[2] 578,149
Tri-State district (Joplin) percent of total..	49	29	34	36	35	37	39
Western States...............do....	30	30	25	29	29	31	31
Other..........................do....	21	41	41	35	36	32	30
World smelter production of zinc short tons..	1,435,000	1,099,000	861,000	1,088,000	1,292,000	1,477,000	1,626,000

[1] Revised figures.
[2] Subject to revision.

DOMESTIC PRODUCTION

Production of primary and secondary slab zinc.—Production of primary slab zinc from domestic and foreign ores in 1936 was 17 percent higher than in 1935 and was equivalent to 82 percent of the average output for the 5-year period 1925–29. It exceeded the depression low established in 1932 by 138 percent. Less than 0.1 percent of the total output in 1936 was derived from foreign ores. Production of secondary slab zinc increased 23 percent from 1935 and was 4 percent above the predepression 5-year average.

Primary and secondary slab zinc produced in the United States, 1927–36, in short tons

Year	Primary			Secondary			Grand total
	Domestic	Foreign [1]	Total	Redistilled	Remelted	Total	
1927	576,960	15,556	592,516	42,784	22,016	64,800	657,316
1928	591,525	11,056	602,581	48,666	22,034	70,700	673,281
1929	612,136	13,311	625,447	47,348	18,052	65,400	690,847
1930	489,361	8,684	498,045	[2] 34,849	14,451	49,300	547,345
1931	291,996	....	291,996	[2] 21,625	13,175	34,800	326,796
1932	207,148	....	207,148	14,718	5,282	20,000	227,148
1933	306,010	1,172	307,182	30,087	18,013	48,100	355,282
1934	355,366	8,224	363,590	19,691	9,609	29,300	392,890
1935	412,184	8,450	420,634	28,650	26,750	55,400	476,034
1936	491,803	329	492,132	42,209	25,791	68,000	560,132

[1] All foreign zinc smelted in the United States was derived from Mexican ores.
[2] Includes 22 tons of secondary electrolytic zinc in 1930 and 312 tons in 1931.

Distilled and electrolytic zinc.—Of the total output of primary zinc in 1936, 74 percent was distilled and 26 percent electrolytic. Production of distilled primary zinc increased 21 percent in 1936, while that of electrolytic zinc increased only 7 percent. The latter was affected adversely by curtailment of operations in Montana the last half of the year owing to shortage of power. Production of redistilled secondary zinc increased 47 percent, the larger part of the increase being in the output at primary smelters.

Distilled and electrolytic zinc, primary and secondary, produced in the United States, 1929–36, in short tons

APPORTIONED ACCORDING TO METHOD OF REDUCTION

Year	Electrolytic primary	Distilled primary	Redistilled secondary [1]		Total
			At primary smelters	At secondary smelters	
1929	156,235	469,212	11,425	35,923	672,795
1930	131,166	366,879	[2] 8,500	26,349	532,894
1931	81,898	210,098	[3] 5,343	16,282	313,621
1932	23,208	183,940	1,596	13,122	221,866
1933	88,315	218,867	14,230	15,857	337,269
1934	76,657	286,933	4,962	14,729	383,281
1935	118,476	302,158	13,439	15,211	449,284
1936	127,175	364,957	22,142	20,067	534,341

APPORTIONED ACCORDING TO GRADE

Year	Grade A (high-grade)	Grade B (intermediate)	Grade C (brass special)	Grade D (selected)	Grade E (prime western)	Total
1929	207,321	27,430	96,163		341,881	672,795
1930	156,494	26,079	93,270		257,051	532,894
1931	83,445	23,924	73,274		132,978	313,621
1932	44,195	13,295	66,844		97,532	221,866
1933	104,842	27,101	57,318		148,008	337,269
1934	116,720	32,621	43,657		190,283	383,281
1935	155,516	49,118	49,909		194,741	449,284
1936	183,841	59,879	65,728		224,893	534,341

[1] For total production of secondary zinc see chapter on Secondary Metals.
[2] Includes 22 tons of secondary electrolytic zinc.
[3] Includes 312 tons of secondary electrolytic zinc.

Production of primary slab zinc by States.—Pennsylvania, with an increase of 26 percent over 1935, continued to rank first in production in 1936, Montana ranked second despite a slight decrease in output, Illinois third, and Oklahoma fourth. All the production of Montana and Idaho is electrolytic zinc, whereas all the other States shown produce distilled zinc.

Primary slab zinc produced in the United States, by States, 1929–36, in short tons

Year	Arkansas	Idaho	Illinois	Kansas	Montana	Oklahoma	Pennsylvania	Other States	Total	
									Short tons	Value
1929	17,923	16,582	112,425	37,795	138,019	111,683	108,167	82,853	625,447	$82,559,000
1930	13,917	9,509	103,331	13,682	112,908	79,742	101,916	63,040	498,045	47,812,000
1931	3,362	8,466	76,290	4,660	63,090	26,924	65,445	43,759	291,996	22,192,000
1932	639	5,955	67,610		17,250	27,226	55,536	32,932	207,148	12,429,000
1933	9,129	7,686	60,140		80,629	52,000	62,583	35,015	307,182	25,803,000
1934	11,808	9,935	55,773		66,722	61,711	100,728	56,913	363,590	31,269,000
1935	10,147	12,448	67,348		106,028	58,612	119,452	46,599	420,634	37,016,000
1936	18,005	21,223	81,174		105,952	62,963	150,425	52,390	492,132	49,213,000

Secondary zinc.—Besides the redistilled and remelted secondary slab zinc (unalloyed) mentioned previously, a large quantity of secondary zinc is recovered each year in the form of alloys, zinc dust, zinc pigments, and zinc salts. Details are given in the chapter on Secondary Metals.

Byproduct sulphuric acid.—An important byproduct of zinc smelting is sulphuric acid made from the sulphur dioxide gases evolved from the roasting of zinc blende. Some of these plants also use large quantities of sulphur in addition to blende to utilize a larger proportion of their acid-producing capacity. The following table shows the production of sulphuric acid at zinc-blende roasting plants from 1929 to 1935. Data for 1936 were not available at the time this chapter was prepared.

Sulphuric acid (60° B. basis) made at zinc-blende roasting plants in the United States, 1929–35

Year	Made from zinc blende		Made from sulphur		Total		
	Short tons	Value [1]	Short tons	Value [1]	Short tons	Value [1]	
						Total	Average per ton
1929	627,018	$6,038,183	646,980	$6,230,417	1,273,998	$12,268,600	$9.63
1930	536,614	5,167,593	474,092	4,565,506	1,010,706	9,733,099	9.63
1931	426,618	3,745,706	[2] 381,216	3,347,077	807,834	7,092,783	8.78
1932	341,340	2,594,184	244,644	1,859,294	585,984	4,453,478	7.60
1933	355,027	2,676,904	242,493	1,828,397	597,520	4,505,301	7.54
1934	[3] 406,984	3,215,173	89,162	704,380	496,146	3,919,553	7.90
1935	[3] 443,476	3,756,242	90,884	769,787	534,360	4,526,029	8.47

[1] At average of sales of 60° acid.
[2] Includes acid made from small quantity of pyrites.
[3] Includes acid from small quantity of foreign blende.

Rolled zinc.—Production of rolled zinc in 1936 decreased 3 percent from 1935. Some producers fabricate their rolled zinc into forms other than those shown in the accompanying table. In 1936, 11,077 tons of scrap resulting from zinc-rolling operations were remelted and rerolled. Zinc lost in waste products, such as skimmings and drosses and pot losses, totaled 1,690 tons in 1936—equivalent to about 3 percent of the net production of rolled zinc. Of the zinc purchased for rolling in 1936, 49 percent was brass special, 20 percent high grade, 16 percent selected, 12 percent prime western, and 3 percent electrolytic and intermediate grade. Stocks of slab zinc on hand at zinc-rolling mills were about 9,500 tons at the beginning and about 7,000 tons at the end of the year.

Rolled zinc produced and quantity available for consumption in the United States, 1935-36

	1935			1936		
	Short tons	Value		Short tons	Value	
		Total	Average per pound		Total	Average per pound
Production:						
Sheet zinc not over 0.1-inch thick	16,061	$2,908,000	$0.091	17,118	$3,262,000	$0.095
Boiler plate and sheets over 0.1-inch thick	1,011	160,000	.079	1,187	198,000	.083
Strip and ribbon zinc [1]	39,469	5,706,000	.072	36,639	5,584,000	.076
Total zinc rolled [1]	56,541	8,774,000	.078	54,944	9,044,000	.082
Imports	112	9,000		242	23,000	
Exports	4,813	755,000	.078	4,483	723,000	.081
Available for consumption	51,840			50,703		
Value of slab zinc (all grades)			.044			.050
Value added by rolling			.034			.032

[1] Figures represent net production. In addition, 13,551 tons of strip and ribbon zinc in 1935 and 11,077 tons of strip and ribbon zinc in 1936 were rerolled from scrap originating in fabricating plants operated in connection with zinc-rolling mills.

Zinc dust.—Commercial production of zinc dust in the United States was begun in 1910, and from 1922 to 1927 the annual production averaged about 8,000 tons. In 1936, 14,425 tons were produced, an increase of 16 percent over 1935 and the largest output ever recorded. The zinc content of zinc dust produced in 1936 averaged 97 percent. Since 1931 virtually all zinc dust has been produced by redistillation of zinc drosses and slab zinc. The production of atomized zinc dust for market is relatively small.

Zinc dust [1] produced in the United States, 1929-36

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average per pound			Total	Average per pound
1929	11,050	$1,864,672	$0.084	1933	11,157	$1,308,594	$0.059
1930	9,237	1,205,740	.065	1934	10,856	1,342,133	.062
1931	10,611	1,148,152	.054	1935	12,453	1,574,259	.063
1932	9,440	900,796	.048	1936	14,425	1,957,300	.068

[1] The zinc dust produced is principally "distilled." Some "atomized" dust was produced in each of the years shown except 1934-36, but the Bureau of Mines is not at liberty to publish the figures separately.

Zinc pigments and salts.—Zinc oxide, leaded zinc oxide, and lithopone are the principal pigments of zinc and chloride and sulphate the principal salts. These products are manufactured from various zinciferous materials—ores, metal, and secondary substances. Details of the production of zinc pigments and salts are given in the chapter on Lead and Zinc Pigments and Zinc Salts.

Mine production.—Mine production of zinc increased 12 percent in 1936 and was equivalent to about 80 percent of the average predepression output. While all sections of the country shared in the advance, the Central States supplied more than half of the increase in tonnage. Oklahoma continued as the principal producer, although registering a decline in output. Kansas and Missouri more than made

up for this loss, so that the Tri-State district recorded a 19-percent rise for the year. In 1936 the district supplied 39 percent of the total production compared with 49 percent from 1925 to 1929. Resumption of operations at Metalline Falls accounted for the larger production in Washington.

Mine production of recoverable zinc in the United States, 1925–29 (average) and 1930–36, in short tons

State	1925–29 average	1930	1931	1932	1933	1934	1935	1936
Western States:								
Arizona	2,628	815			6	905	3,337	[1] 3,950
California	3,999		80		145	361	161	[1] 8
Colorado	32,868	36,259	16,187	109	1,285	772	1,202	1,172
Idaho	29,128	37,649	19,569	10,252	20,968	24,799	31,053	49,500
Montana	72,519	26,421	6,747	2,197	20,724	30,721	54,781	[1] 49,623
Nevada	5,570	14,584	10,431	127	6,387	13,940	15,536	[1] 15,785
New Mexico	23,351	32,765	27,866	25,593	30,924	26,522	22,126	20,668
Oregon		6		6	6	37		61
Utah	44,385	44,495	37,291	29,666	29,745	28,198	31,107	36,192
Washington	575	352	4,974	2,245	3,369	1,926	1	4,403
	215,023	193,346	123,145	70,195	113,559	128,181	159,304	180,962
Central States:								
Arkansas	71				11	68	153	182
Illinois	1,174	9						
Kansas	114,323	74,304	39,051	26,277	40,947	38,261	54,110	79,017
Kentucky	644			46	228	125	127	238
Missouri	16,708	10,811	3,205	986	5,042	7,059	7,263	18,709
Oklahoma	226,969	136,153	78,132	63,437	91,065	107,772	129,763	129,175
Wisconsin	23,055	12,558	10,088	7,522	7,800	9,807	8,923	8,126
	382,944	233,835	130,476	98,268	145,093	163,092	200,339	235,447
Eastern States:								
New Jersey	93,839	97,626	94,285	81,460	75,125	76,553	85,708	89,883
New York	7,091	22,471	24,100	16,794	17,733	23,188	23,720	26,941
Tennessee and Virginia [2]	25,823	48,147	38,312	18,514	32,770	47,712	48,832	44,916
	126,753	168,244	156,697	116,768	125,628	147,453	158,260	161,740
	724,720	595,425	410,318	285,231	384,280	438,726	517,903	[1] 578,149

[1] Subject to revision.
[2] Bureau of Mines not at liberty to publish figures for Tennessee and Virginia separately.

Mine production of recoverable zinc in the principal zinc-producing districts of the United States, 1929–36, in short tons

District	State	1929	1930	1931	1932	1933	1934	1935	1936
Joplin region	Kansas, Missouri, Oklahoma.	309,436	216,961	119,168	90,660	137,054	153,092	191,136	226,857
New Jersey	New Jersey	103,740	97,626	94,285	81,460	75,125	76,553	85,708	89,883
Eastern Tennessee Austinville	Tennessee Virginia	40,558	48,147	38,312	18,514	32,770	47,712	48,832	44,916
Summit Valley (Butte)	Montana	50,550	13,984			15,481	21,165	37,646	(1)
Coeur d'Alene region	Idaho	43,046	33,145	18,934	10,251	20,958	24,799	31,009	44,310
St. Lawrence County	New York	10,250	22,471	24,100	16,794	17,733	23,188	23,720	26,941
Bingham	Utah	21,794	22,362	26,608	21,746	20,648	16,611	17,996	17,422
Willow Creek	New Mexico	22,865	16,638	20,817	20,356	18,665	16,847	13,372	9,667
Pioche	Nevada	6,498	11,086	6,708		4,188	11,196	12,183	(1)
Central	New Mexico	11,224	15,319	7,050	5,121	11,220	9,109	8,404	10,706
Park City region	Utah	27,965	19,543	9,436	7,863	8,296	9,693	9,659	13,579
Upper Mississippi Valley.	Iowa, northern Illinois, Wisconsin.	17,017	12,567	10,088	7,522	7,800	9,807	8,923	8,126
Ophir	Utah			10		32	920	2,167	3,563
Leadville	Colorado	13,414	11,519	2,887	63	1,246	515	924	871
San Juan Mountains	do	14,403	10,434	41	4	9	125	153	140
Warm Springs	Idaho	2,488	3,073			10		39	4,771
Metaline Falls	Washington	1,031	352	4,974	2,245	3,369	1,926		4,389
Battle Mountain	Colorado	420	14,272	13,259					
Southeastern Missouri region.	Missouri	3,473	4,307	1,220	40				44

[1] Data not yet available.

STOCKS

Stocks of slab zinc on hand at primary and secondary smelters at the end of 1936 were the lowest since 1928. Stocks of the higher grades of zinc (A and B) declined from 13,546 tons at the beginning of the year to 7,536 tons at the close. Stocks of the lower grades (C, D, and E) were reduced from 78,144 tons to 48,590 tons. Less than 1 month's supply of zinc was on hand at the end of 1936.

Stocks of zinc on hand at zinc-reduction plants in the United States at end of year, 1929–36, in short tons

	1929	1930	1931	1932	1933	1934	1935	1936
At primary reduction plants	85,904	167,293	143,592	128,192	110,487	124,783	90,539	55,500
At secondary distilling plant	3,549	1,909	2,497	3,370	2,479	2,685	1,151	626
	89,453	169,202	146,089	131,562	112,966	127,468	91,690	56,126

Stocks of zinc ore in the Tri-State district also declined during 1936. On January 1 there was on hand about 17,000 tons of concentrates with an estimated recoverable zinc content of 9,000 tons, whereas on December 31 stocks of ore were less than 12,000 tons, representing about 6,000 tons of metal.

The only data available on stocks of slab zinc outside of the United States for 1936 are trade estimates. The British Metal Corporation, Ltd., in its review of nonferrous metals for 1935, stated that zinc stocks ex United States probably were less than 110,000 tons at the close of that year. For 1936, however, the corporation gives no estimate of totals but suggests that stocks may have declined about 10,000 tons. On this assumption foreign stocks of 100,000 tons at the end of 1936 are indicated, which, added to domestic holdings of 56,000 tons, makes a world total of 156,000 tons compared with 200,000 tons at the end of 1935.

DOMESTIC CONSUMPTION

New supply.—The supply of new zinc available for consumption in 1936 increased 18 percent over 1935 and equaled 98 percent of the 5-year predepression average. This remarkable recovery in zinc consumption exceeds that of copper, lead, and pig iron to a considerable extent, as consumption of new copper in 1936 was only 84 percent of the 1925–29 average, lead 55 percent, and pig iron 81 percent. The better showing of primary zinc may be ascribed to the fact that a smaller proportion of zinc than of copper and lead is consumed in the manufacture of capital goods, production of which has lagged behind consumers' goods. A large proportion of zinc is used in galvanized wares, paint pigments, radio and flashlight batteries, fruit-jar covers, and other items that pass on to the consuming public rapidly. Moreover, the uses to which zinc is put are such that there is much less return of scrap than for lead and copper.

Primary slab zinc available for consumption in the United States, 1929–36, in short tons

	1929	1930	1931	1932	1933	1934	1935	1936
Supply:								
Stock at smelters Jan. 1	[1] 48,432	85,904	167,293	143,592	128,192	110,487	124,783	90,539
Production	625,447	498,045	291,996	207,148	307,182	363,590	420,634	492,132
Imports	226	281	274	310	1,890	1,725	4,444	11,660
Total available	674,105	584,230	459,563	351,050	437,264	475,802	549,861	594,331
Withdrawn:								
Exports	14,411	4,633	643	6,471	1,145	5,105	1,617	37
Stock at smelters Dec. 31	85,904	167,293	143,592	128,192	110,487	124,783	90,539	55,500
Total withdrawn	100,315	171,926	144,235	134,663	111,632	129,888	92,156	55,537
Available for consumption	[2] 573,790	[2] 412,304	[2] 315,328	[2] 216,387	[2] 325,632	[2] 345,914	[2] 457,705	538,794

[1] Includes stocks at secondary distilling plants.
[2] Revised figures.

Industrial use of slab zinc.—In addition to the new supply noted above, a large tonnage of secondary zinc is available each year for industrial use. The American Bureau of Metal Statistics estimates the total industrial use of primary and secondary zinc during the past 8 years as follows:

Estimated industrial use of zinc in the United States, 1929–36, in short tons [1]

Purpose	1929	1930	1931	1932	1933	1934	1935	1936
Galvanizing:								
Sheets	142,800	103,900	77,100	52,500	74,400	83,300	110,000	132,000
Tubes	52,200	38,800	28,300	16,000	22,600	22,000	25,000	36,000
Wire	39,000	25,100	21,600	12,100	21,700	20,000	25,000	30,000
Wire cloth	10,800	9,400	6,900	4,400	4,800	4,000	5,000	6,000
Shapes [2]	45,200	39,800	34,100	24,000	24,500	22,700	30,000	38,000
	290,000	217,000	168,000	109,000	148,000	152,000	195,000	242,000
Brass and castings [3]	185,000	120,000	98,000	66,000	94,000	98,000	124,000	168,000
Rolled zinc	[4] 68,300	[4] 51,400	49,300	40,000	41,300	40,900	56,500	55,000
Die castings	36,000	21,500	20,000	17,000	26,000	32,000	55,500	72,000
Other purposes [5]	55,000	41,000	34,700	27,000	41,000	37,000	42,000	48,000
	634,300	450,900	370,000	259,000	350,300	359,900	473,000	585,000

[1] Year Book, American Bureau of Metal Statistics, 1936.
[2] Includes pole-line hardware, hollow ware, chains, and all articles not elsewhere mentioned. The estimates for the use of slab zinc under this head, and also for wire cloth, are probably incomplete.
[3] Includes all casting other than die casting, slush casting, and battery zinc.
[4] Includes some duplication of tonnage.
[5] Includes slab zinc used for manufacture of French oxide, lithopone, atomized zinc dust, wire, and zinc for wet batteries, slush castings, and desilverization of lead.

The industrial use of zinc in 1936 was the largest recorded since 1929. All important uses except rolled zinc took larger tonnages than in 1935, and the quantity used for die castings was twice that recorded in 1929. Galvanizing used 41 percent of the total zinc consumed in 1936 and took 24 percent more tonnage than in 1935. The totals for this item include 4,587 tons used in electrogalvanizing in 1936 and 3,115 tons in 1935, mostly in the manufacture of wire and wire cloth. Of the rolled zinc produced in 1936 (1935 figures in parentheses), 18,700 (15,300) tons were used for battery cans; 15,500 (18,000) for glass-jar tops; 1,200 (1,000) for boiler plate and special sheet not over 0.1 inch thick; 4,500 (4,800) for export; and the rest for miscellaneous purposes. Increased use of zinc in brass in 1936 reflects greater activity in automobile manufacture and building.

The sale of brass pipe for water lines is said to have exceeded all previous records. The principal use included in "other purposes" is French process zinc oxide, in the manufacture of which nearly 33,000 tons of slab zinc were used in 1936, compared to 27,000 tons in 1935. Other important miscellaneous uses include slush castings, cast zinc for wet batteries (2,174 tons in 1936), and lead desilverization. For the manufacture of brake lining 500 tons of zinc wire was used in 1936 and 300 tons in 1935.

PRICES

The price of zinc increased further in 1936. The average for prime western at St. Louis was 13 percent above the 1935 price but was still 28 percent below the 1925–29 average. Zinc, however, has fared better than copper and lead as to price advances, as 1936 averages for those two metals were, respectively, 35 and 37 percent below predepression levels.

At the beginning of the year the quotation stood at 4.85 cents. There was little change during the first half of the year, but from the latter part of June to the middle of July there was a temporary sag from 4.90 to 4.75 cents, the latter proving to be the low for the year. During the last 2 months buying became brisk, and the quotation rose from 4.85 cents early in November to 54.5 cents at the close of the year.

Domestic price movements were restricted by the London market, which was held back most of the year by an abundance of supplies. For the first 10 months of 1936 the differential between London and New York prices averaged about 2 cents. Since this was higher than the United States import duty of 1¾ cents, domestic producers could not raise prices farther without losing business to foreign producers. The upward swing in prices resulting from the buying spree that began the latter part of the year was more pronounced in Europe than in the United States. London prices therefore moved forward more rapidly, and by December the differential between London and New York had declined to 1.72 cents. In March 1937, London prices actually exceeded domestic quotations.

The price of 60-percent zinc concentrates at Joplin was 11 percent higher than in 1935. The smelter margin was 2.24 cents per pound of zinc compared with 1.93 cents in 1935 and 2.96 in 1929.

Prices of zinc and zinc concentrates, 1929–36

	1929	1930	1931	1932	1933	1934	1935	1936
Average price of common zinc at—								
St. Louis (spot)........cents per pound..	6.49	4.56	3.64	2.88	4.03	4.16	4.33	4.90
New York........................do....	6.84	4.91	3.99	3.25	4.40	4.51	4.70	5.28
London..........................do....	5.40	3.60	2.52	2.12	2.96	3.07	3.08	3.31
Excess New York over London.........do....	1.44	1.31	1.47	1.13	1.44	1.44	1.62	1.97
Joplin 60-percent zinc concentrates:								
Price per short ton..............dollars..	42.39	31.97	22.69	17.83	26.88	27.14	28.81	31.95
Price of zinc content....cents per pound..	3.53	2.66	1.89	1.49	2.24	2.26	2.40	2.66
Smelter margin..................do....	2.96	1.90	1.75	1.39	1.79	1.90	1.93	2.24
Price indexes (1925–29 average=100):								
Zinc (New York)........................	96	69	56	46	62	63	66	74
Lead (New York)........................	91	74	57	43	52	52	54	63
Copper (New York)......................	123	89	56	38	48	58	59	65
Nonferrous metals [1]......................	107	83	63	50	60	68	69	72
All commodities [1]........................	97	88	74	66	67	76	81	82

[1] Based on price indexes of the U. S. Department of Labor.

Average monthly quoted prices of common zinc (prompt delivery or spot) at St. Louis and London, and of 60-percent zinc concentrates at Joplin, 1935–36 [1]

Month	1935			1936		
	60-percent zinc concentrates in the Joplin region (dollars per ton)	Metallic zinc (cents per pound)		60-percent zinc concentrates in the Joplin region (dollars per ton)	Metallic zinc (cents per pound)	
		St. Louis	London		St. Louis	London
January	26.00	3.73	2.62	32.00	4.85	3.21
February	26.00	3.72	2.57	32.00	4.86	3.38
March	26.00	3.90	2.58	32.00	4.90	3.55
April	25.72	4.03	2.78	32.00	4.90	3.35
May	26.00	4.22	3.17	32.00	4.90	3.23
June	27.93	4.30	3.03	32.00	4.88	3.11
July	28.00	4.33	3.11	30.76	4.79	3.04
August	29.50	4.54	3.26	31.00	4.80	3.04
September	30.00	4.67	3.39	31.12	4.85	3.13
October	31.55	4.83	3.60	31.50	4.85	3.18
November	32.00	4.86	3.56	31.86	4.98	3.56
December	32.00	4.85	3.32	33.81	5.28	3.93
Average for year	28.81	4.33	3.08	31.95	4.90	3.31

[1] All quotations from Metal Statistics, 1937. Conversion of English quotations into American money based on average rates of exchange recorded by the Federal Reserve Board of the Treasury.

Average price of zinc received by producers, 1929–36, by grades, in cents per pound

	1929	1930	1931	1932	1933	1934	1935	1936
Grade A (high grade) [1] / Grade B (intermediate)	6.80	4.92	4.00	3.25	4.35	4.50	4.55	5.15
Grades C and D (select and brass special)[1]	6.44	4.71	3.63	2.95	3.98	4.10	4.31	4.91
Grade E (prime western)	6.42	4.69	3.73	2.85	4.07	4.15	4.32	4.89
All grades	6.6	4.8	3.8	3.0	4.2	4.3	4.4	5.0
Prime western; spot quotation at St. Louis	6.5	4.6	3.6	2.9	4.0	4.2	4.3	4.9

[1] American Metal Market quotes average prices of high grade and brass special as follows: High grade (f. o. b. New York), 1929, 7.88 cents; 1930, 5.58 cents; 1931, 4.63 cents; 1932, 3.99 cents; 1933, 5.25 cents; 1934, 5.24 cents; 1935, 5.33 cents; 1936, 5.90 cents; brass special (f. o. b. East St. Louis), 1929, 6.60 cents; 1930, 4.64 cents; 1931, 3,73 cents; 1932, 2.96 cents; 1933, 4.08 cents; 1934, 4.23 cents; 1935, 4.41 cents; 1936, 4.98 cents.

ZINC-REDUCTION PLANTS

Zinc smelters.—At the close of 1936 there were 21 primary zinc-distillation plants in the United States, of which 17 were active sometime during the year and 4 were idle throughout the year. The Illinois Zinc Co. shut down its smelter at Peru, Ill., and started up its new plant at Dumas, Tex. The new plant has two natural-gas-fired horizontal-retort blocks and is reported to have the capacity to produce 12,000 tons of metal annually. Dismantling the plant at Kusa, Okla., which had been idle since 1932, was completed in 1936. The St. Joseph Lead Co. began large-scale production of metallic zinc at its electrothermic smelter near Josephtown, Pa. Formerly this plant had been producing only zinc oxide. Early in 1937 the Van Buren, Ark., smelter, which shut down in 1927, was acquired by interests associated with the Eagle Picher Mining & Smelting Co. According to reports, the plant will be rehabilitated and put into operation soon. Additional vertical-retort furnaces were installed at Palmerton during 1936.

At 16 plants active during 1936 there was a total of 66,972 horizontal retorts available for use, of which 40,903 were in operation at the close

of the year. At 3 of these plants there were 52 continuous vertical-retort furnaces, all of which were in production at the close of the year.

Many of the primary smelters treat scrap as well as ore. Horizontal-retort plants at Beckemeyer and Sandoval, Ill., and large graphite retort plants at Trenton, N. J., Philadelphia and Bristol, Pa., Wheeling, W. Va., and Tottenville, N. Y., operate exclusively on scrap.

Electrolytic plants.—The Evans-Wallower Zinc Co. plant at East St. Louis has been idle since 1931. The Anaconda plant of the Anaconda Copper Mining Co. resumed operations early in 1936 and the Great Falls plant was active all year, but operations at both plants were curtailed during the last half of the year owing to shortage of power as a result of the drought. The Kellogg plant of the Sullivan Mining Co. maintained full-scale production during 1936, and a substantial increase in capacity is being planned. At the 3 active plants, 1,464 cells out of a total of 2,040 were in use at the end of the year.

TECHNOLOGY

Mining.—Mechanical loading has been an important factor in reducing the cost of mining and in making possible operations in mines where high temperatures preclude efficient hand shoveling. A survey [2] conducted by the Bureau of Mines shows that from 1923 to 1936, 3,752 scraper loaders and 470 shovel loaders were added to the mechanical equipment of underground metal and nonmetallic mines in the United States. It also shows that interest in mechanical loading is widespread and that the potential use of such equipment is large. Adoption of mechanical loading in the Tri-State district has been retarded by the small scale of the operations under which capital investment for mechanical equipment would not be justified. Several zinc mines in the Eastern, Southern, and Western States are equipped with mechanical loaders.

Detachable drill bits appear to be gaining favor, although opinions on their merits vary greatly. The Bureau of Mines has issued two reports on the subject, Information Circulars 6877 and 6911. At plants not equipped with elaborate drill-sharpening equipment for old-style drill steel, hot milling is preferred to forging methods. The practice in the Wisconsin zinc fields is described in Bureau of Mines Information Circular 6907.

At the Sullivan mine, British Columbia, the problem of mining pillars has necessitated the filling of rather flat-dipping open stopes. This is being accomplished by discharging a free-flowing mud into the stopes through openings at the surface. Excess water is drained from the mud through outlets provided in a concrete dam constructed at the bottom of the stope. On the surface, clay and gravel are conveyed, by means of bulldozers of the caterpillar type, to a grizzly covering the raise from the stope. The water is added just below the grizzly and mixes with the dry dirt as the mass descends. It is expected that the mixture will set sufficiently to permit easy pillar recovery.

Milling.—R. A. Pallanch [3] aptly calls attention to the fact that metallurgical practice is governed to a large extent by economic considerations and that the efficiency of separation processes must be

[2] Plein, L. N., Berquist, F. E., and Tryon, F. G., Mechanical Loading Underground: Eng. and Min. Jour., vol. 138, no. 5, 1937, p. 241.

[3] Pallanch, R. A., Factors Governing the Separation of Lead and Zinc in Ore by Flotation: Min. and Met., vol. 17, no. 356, 1936, pp. 386–389.

gaged in terms of "economic recovery." He also points out that while selective flotation has been a boon to the lead-zinc millman, it has its limitations. These can be determined by use of the microscope, thus eliminating much useless effort in trying to achieve impossible results.

In the Tri-State district, the Eagle-Picher Mining & Smelting Co. has announced its intention to increase the capacity of the central mill from 6,000 to 10,000 tons per day. This company apparently is looking forward to an increased supply of ore from the older sections of the district in the vicinity of Joplin. In this connection, the use of screens and picking belts by the Webb City Lead & Zinc Co. to improve the grade of ore in the Webb City-Oronogo field from 4.5 percent zinc to 7 and 8 percent is of interest. The higher-grade product can be shipped profitably to Eagle-Picher's Central mill.

A new edition of Flotation Plant Practice by P. Rabone was published in 1936.

Reduction.—No branch of metallurgy has shown more improvement in the last decade than that of zinc. Refinements in the electrolytic process and the introduction of large, vertical, continuously operated retorts have threatened extinction of the small horizontal-retort process, which had been standard practice for over a century. However, the erection in 1936 of a new plant using horizontal-retort smelting indicates that under some conditions, this process is still desirable. The new plant is that of the Illinois Zinc Co., at Dumas, Tex. It contains two gas-fired retort blocks with a capacity of 12,000 tons of metal per year, and further increase in capacity is anticipated. The plant uses natural gas as fuel and smelts zinc ores from the company mine in New Mexico.

The Queneau process offers possibilities for the production of higher grades of zinc by retort smelting and improved recovery of byproducts such as cadmium. The calcined concentrate is subjected to a chloridizing roast, which removes most of the contaminating metals and leaves an exceptionally pure product for zinc distillation. A similar process, in which fluorides are used instead of chlorides, also has been proposed.

Bunce[4] has described the vertical-retort, continuous-smelting process developed by the New Jersey Zinc Co. Twelve new furnaces were installed at Palmerton during 1936, making the total 28 at this plant. This type of furnace is used also at Depue, Ill.; Meadowbrook, W. Va.; Avonmouth, England; and Oker, Harz, Germany.

According to U. C. Tainton,[5] major improvements in the electrolytic process cannot be visualized except by a complete change in the method of attack. The modern plant makes metal 99.99 percent pure with 99.999 percent metal in the offing. Recovery ranges from 95 to 99 percent of the zinc contained in the feed. Conversion of high-tension alternating to direct current is accomplished with an efficiency of about 95 percent, and current efficiencies are 90 percent or better. Large-scale production has cut labor costs to very little. The Sullivan plant at Kellogg, Idaho, is being enlarged, and several new plants are under construction abroad. During 1936 a second plant for zinc-coating steel wire by electrolysis was put into operation at Johnstown, Pa. The plant uses roasted zinc ore as a raw material.

---

[4] Bunce, E. H., An Advance in Zinc Smelting: Eng. and Min. Jour., vol. 137, no. 11, December 1936, pp. 599–607.

[5] Tainton, U. C., Metallurgy of Zinc: Min. and Met., vol. 18, no. 361, January 1937, p. 17.

Commercial production of metallic zinc by electrothermic smelting was begun in 1936 at the Josephtown, Pa., plant of the St. Joseph Lead Co. The smelter was erected in 1930, but heretofore it has produced only zinc oxide. Sulphuric acid is produced as a byproduct. The process was described by George F. Weaton at the February 1937 meeting of the American Institute of Mining and Metallurgical Engineers. Weaton's paper, as well as many others describing the present state of zinc metallurgy, is included in volume 121, Transactions of the Institute, entitled "Metallurgy of Lead and Zinc", published in 1937.

FOREIGN TRADE [6]

Imports.—The following tables give zinc imports into the United States from 1930–36, inclusive, and a record of bonded-warehouse inventories.

Zinc ores imported into the United States, 1930–36, in short tons [1]

Year	Canada	Mexico	Other countries	Total	Year	Canada	Mexico	Other countries	Total
1930	13	25,644	182	25,839	1934	(2)	14,277	(2)	14,277
1931	(2)	778	2	780	1935		10,520		10,520
1932		1,904		1,904	1936		172		172
1933	44	2,089	(2)	2,133					

[1] Data for 1934–36 include ore imported for immediate consumption plus material entering the country under bond, as do figures for earlier years.
[2] Less than 1 ton.

Zinc remaining in warehouse in the United States, Dec. 31, 1930–36

Year	Ore		Blocks, pigs, and old		Zinc sheets	
	Zinc content (pounds)	Value	Pounds	Value	Pounds	Value
1930	27,185,311	$784,670			43,334	$2,081
1931	22,377,439	269,019	22,909	$160	71,089	2,896
1932	10,211,618	240,338			43,339	2,071
1933	7,985,703	178,291	101,523	7,622		
1934	[1] 14,354,435	(2)	(1)	(1)	(2)	(2)
1935	[1] 13,840,586	(2)	(1)	(1)	(2)	(2)
1936	[1] 10,690,832	(2)	(1)	(1)	(2)	(2)

[1] "Blocks, pigs, and old" included with "ore"; not separately recorded.
[2] Data not available.

Imports of zinc ore virtually ceased in 1936 and were the lowest recorded in over 30 years, but imports of slab zinc more than doubled and were the highest since the beginning of the century. Of the 11,660 tons received in 1936, 6,869 came from Mexico, 2,301 from Norway, 1,204 from Canada, 1,058 from Poland, and 228 from other countries. Much of the metal imported is used in manufactures and exported with benefit of draw-back.

[6] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Zinc imported for consumption in the United States, 1930–36

Year	Blocks or pigs		Sheets		Old		Zinc dust		Value of manufactures	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1930	281	$25,389	65	$6,420	[1] 35	[1] $1,968	76	$7,086	$76,062	$116,925
1931	274	14,793	20	2,283	(2)	35	1	97	13,591	30,799
1932	310	20,132	39	4,636			11	966	9,318	35,052
1933	1,890	127,416	46	6,703			31	2,244	7,400	143,763
1934	1,725	112,923	55	6,978			18	1,395	8,523	129,819
1935	4,444	270,350	112	9,423	[3] 29	[3] 979	40	2,486	1,149	284,387
1936	11,660	770,496	242	23,077	[4] 15	[4] 769	56	3,647	540	798,529

[1] Includes 33 tons of dross and skimmings, valued at $1,829, imported June 18 to Dec. 31; not separately recorded prior to change in tariff.
[2] Less than 1 ton.
[3] Includes 29 tons of dross and skimmings valued at $974.
[4] Includes 14 tons of dross and skimmings valued at $721.

Exports.—The total value of the 1936 exports of zinc ore and domestic and foreign manufactures of zinc (not including galvanized products, alloys, and pigments) was approximately $1,008,000, a decrease of 7 percent from 1935 and 94 percent from the recent high in 1925. Exports of sheet and strip zinc declined 7 percent in 1936. Besides the items shown in the accompanying tables, considerable zinc is exported each year in the form of brass and pigments and in galvanized iron and steel. The American Bureau of Metal Statistics estimates that 10,900 tons of zinc were exported in galvanized products in 1936 compared with 12,800 tons in 1935. Export data on zinc pigments and chemicals are given in the chapter on lead and zinc pigments and zinc salts. Much of the zinc used in the manufacture of these products is of foreign origin and when exported a draw-back is paid amounting to 99 percent of the import duty. In 1936, draw-back was paid on 8,909 tons of zinc, of which 5,009 tons had been imported as slabs and 3,900 tons as ore. Totals for previous years were: 1935, 7,297 tons; 1934, 4,139 tons; and 1933, 857 tons.

Domestic zinc ore and domestic manufactures of zinc exported from the United States, 1930–36

Year	Zinc ore and concentrates		Pigs or slabs [1]		Plates and sheets		Zinc dross		Zinc dust	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1930			4,633	$450,417	3,868	$761,007	1,162	$57,288	1,177	$194,252
1931	13	$373	643	51,010	2,759	461,130	382	19,218	1,400	204,277
1932			6,471	277,612	3,010	432,849	178	8,357	1,378	189,236
1933	[2] 809	[2] 43,650	1,145	79,274	3,189	467,742	(2)	(2)	1,569	234,125
1934	[2] 3,621	[2] 157,419	5,105	284,023	3,462	569,208	(2)	(2)	1,489	223,868
1935	[2] 461	[2] 10,818	1,617	83,925	4,813	755,033	(2)	(2)	1,613	238,158
1936	[2] 245	[2] 5,902	37	4,962	4,483	723,142	(2)	(2)	1,783	273,813

[1] Includes slab zinc made from foreign ore. Not separately recorded.
[2] Zinc dross included with ore and concentrates; not separately recorded.

Slab and sheet zinc exported from the United States, 1933–36, by destinations, in short tons

Destination	Slabs, blocks, or pigs				Sheets, strips, etc.			
	1933	1934	1935	1936	1933	1934	1935	1936
Countries:								
Canada	[1]	5	5	5	1,417	1,442	2,159	1,999
Chile	14	3	7	7	3	2	2	6
France					25	18	12	3
Germany	11		72		2	6	8	4
India (British)		1,849	1,121		[1]	2	2	3
Japan	758	471		1	220	159	191	199
United Kingdom		2,562	1		991	1,161	1,367	1,048
Others	362	215	411	24	531	672	1,072	1,221
Total	1,145	5,105	1,617	37	3,189	3,462	4,813	4,483
Continents:								
North America	4	38	43	19	1,562	1,617	2,379	2,164
South America	43	31	21	10	254	271	285	243
Europe	335	2,708	425		1,087	1,296	1,587	1,151
Asia	763	2,320	1,128	8	272	223	382	679
Africa					11	13	15	1
Oceania		8	[1]		3	42	165	245

[1] Less than 1 ton.

WORLD ASPECTS OF THE ZINC INDUSTRY

International (European) Zinc Cartel.—Efforts to revive the Zinc Cartel, which had collapsed in December 1934, were continued throughout 1936 but without success. Producers in Belgium and the United Kingdom led in negotiations for an agreement to control excess supplies, which were having an adverse effect on prices. British producers urged the adoption of such an agreement in lieu of an increase in the tariff on zinc, which, as revised in 1935, they said, had proved to be inadequate. In July a general 10-percent cut in production was proposed, but German, Italian, and French interests were apathetic. It was also rumored at one time that a proposal had been made to pool part of the concentrate production for 1 year. Toward the latter part of the year, as the market improved, interest in revival of the cartel dwindled.

World production.—World production of zinc (smelter basis) increased 10 percent in 1936 and was the highest on record, exceeding the previous peak established in 1929 by about 2 percent. Compared with 1935 the United States showed greater improvement than the rest of the world, the respective increases being 17 and 7 percent. Compared with 1929, however, the production of foreign countries increased 16 percent, whereas that of the United States decreased 21 percent. From 1929 to 1936 the United States proportion of the world total declined from 39 to 30 percent.

World smelter production of zinc, 1929–36, in metric tons, by countries where smelted

[Compiled by R. B. Miller]

Country	1929	1930	1931	1932	1933	1934	1935	1936
Australia	52, 705	55, 782	54, 696	54, 054	54, 822	55, 506	68, 234	77, 741
Belgium	197, 900	176, 230	134, 720	96, 330	137, 300	174, 900	181, 740	197, 685
Canada	78, 061	110, 219	107, 612	78. 146	83, 412	122, 394	135, 645	138, 410
Czechoslovakia	10, 675	13, 472	7, 947	6, 031	6, 605	7, 634	9, 664	10, 900
France	87, 330	86, 928	57, 113	45, 700	51, 958	47, 248	52, 087	54, 000
Germany [1]	102, 000	97, 300	45, 300	41, 979	50, 774	71, 196	124, 216	136, 422
Indochina	3, 808	3, 857	2, 900	2, 280	3, 250	4, 960	3, 936	[2] 4, 100
Italy	15, 804	19, 264	16, 913	17, 984	23, 283	24, 864	27, 579	26, 000
Japan	22, 098	24, 669	25, 407	27, 043	30, 658	32, 145	34, 191	36, 202
Mexico	15, 099	29, 431	35, 619	30, 349	26, 799	29, 148	32, 327	32, 211
Netherlands	25, 712	23, 255	19, 323	15, 624	18, 478	19, 911	13, 747	15, 428
Northern Rhodesia	12, 316	18, 194	7, 038	-------	18, 839	19, 854	21, 012	21, 063
Norway	5, 516	34, 611	39, 472	39, 373	44, 948	45, 027	45, 019	(3)
Poland	169, 029	174, 362	130, 756	84, 953	82, 866	92, 921	84, 606	92, 534
Spain	11, 825	10, 697	10, 094	9, 505	8, 548	8, 184	8, 916	(3)
Sweden	4, 718	4, 126	-------	-------	-------	-------	-------	-------
U. S. S. R. (Russia)	[4] 3, 437	[4] 4, 650	11, 400	14, 116	16, 620	27, 084	47, 910	63, 720
United Kingdom [5]	59, 234	49, 378	21, 582	27, 300	46, 000	55, 000	64, 000	66, 116
United States	567, 393	451, 816	264, 893	187, 921	278, 669	329, 842	381, 591	446, 452
Yugoslavia	6, 291	5, 514	4, 504	2, 157	3, 461	4, 037	3, 356	3, 599
	1, 451, 000	1, 394, 000	997, 000	781, 000	987, 000	1, 172, 000	1, 340, 000	1, 475, 000

[1] Exclusive of secondary material (Metallgesellschaft). The figures published by the Stat. Reichsamt, which include secondary material, are as follows: 1929, 108,429 tons; 1930, 101,385 tons; 1931, 48,621 tons; 1932, 45,035 tons. Similar data not available for 1933–36.
[2] Approximate production.
[3] Data not available. Estimate included in total.
[4] Year ended Sept. 30.
[5] Some secondary material included.

World consumption.—World consumption of zinc in 1936 exceeded all previous records. According to the American Bureau of Metal Statistics it amounted to 1,529,100 metric tons, which was 13 percent above that of 1935 and 4 percent over the previous peak consumption in 1929. There was a greater increase in the use of zinc in the United States in 1936, as compared with 1935, than in the rest of the world, domestic consumption having increased 22 percent, whereas elsewhere it increased only 9 percent. Compared with 1929, however, the United States lags behind. The quantity of zinc consumed in 1936 in foreign countries was 9 percent more than that of 1929, but in the United States it was 4 percent below.

The United States continued to be the largest consumer, having taken about 34 percent of the total. Next in order in percentage of total consumed were United Kingdom 14 percent, Germany 14 percent, Belgium 7 percent, France 6 percent, Japan 5 percent, U. S. S. R. (Russia) 4 percent, and Poland and Italy each 2 percent. France was the only important consumer to take less in 1936. Consumption in other nations increased as follows: United Kingdom 10 percent, Germany 5 percent, Belgium 10 percent, Japan 22 percent, U. S. S. R. (Russia) 39 percent, Poland 19 percent, and Italy about 1 percent.

REVIEW BY COUNTRIES

Australia.—Australia's increase in production of metal in 1936 was the result of the first full year's operation of the new unit of the Risdon electrolytic zinc plant. At Broken Hill production of ore increased to 1,350,300 long tons, an advance of 42,700 tons over 1935. Zinc-concentrate production increased from 220,767 to 243,604 tons. Production of zinc concentrates was begun at Mount Isa in 1936, and

the output for the year contained over 30,000 tons of zinc. Exports were begun in March but were suspended in September. The company stated that freight rates were exorbitant, amounting to 40 percent of the sales value of the concentrates. In February 1937 it was stated that 35,000 tons of concentrates were stocked and awaiting shipment. The Rosebery mine in Tasmania resumed production in February, and early in 1937 it was reported that a 1,000-ton mill was to be erected to treat ore from the Lake George mine, New South Wales. Exports of slab zinc and concentrates from Australia increased in 1936.

Belgium.—Imports of zinc ore amounted to 576,000 metric tons in 1936, an increase of 37 percent over 1935. Larger shipments were obtained from Mexico, Peru, Newfoundland and Canada, and Australia, but receipts from Yugoslavia and British India declined. Exports of zinc slabs and zinc sheets were 92,000 tons and 45,500 tons, respectively, representing a decline from 1935. It was reported that Vieille Montagne and Sociètè Anonyme Metallurgique de Prayon had taken over control of Sociètè Anonyme La Nouvelle Montagne. The new 6,000-ton electrolytic zinc plant of Vieille Montagne operated throughout the year. Export business is an important factor in the Belgian zinc-smelting industry, and the increasing number of import restrictions being adopted throughout the world constitute a serious threat to Belgium's producers. In 1936 it was suggested that further limitation of available world markets would force Belgium to extend its activity in the fabrication of zinc products.

Canada.—Eighty percent of Canada's production of metallic zinc was made at Trail and 20 percent at Flin Flon. Production at Trail increased 5 percent and that at Flin Flon 7 percent. Exports of slab zinc increased 3 percent, to 140,000 short tons, of which the United Kingdom took 81 percent and Japan 12 percent. Exports of zinc in the form of ore increased from 9,800 to 19,566 tons, Belgium taking 81 percent of the latter. Increase in exports of ore resulted from resumption of operations at the Stirling mine in Nova Scotia. The Britannia mine in British Columbia and the Tetreault mine in Quebec also exported more zinc concentrates in 1936. Sherritt-Gordon is considering reopening its mine in Manitoba during 1937, and preliminary steps have been taken to reopen the Waite Amulet mine in Quebec.

Czechoslovakia.—Zinc producers applied to the Government for an increase in import duties to permit them to engage in the production of electrolytic zinc, hitherto imported. Consumers protested on the ground that such action would be uneconomic. Apparently no action was taken.

France.—French subsidies to domestic and colonial producers did not succeed in increasing materially the mine output. Higher zinc prices toward the end of the year, together with devaluation of the franc in September, improved the situation somewhat, and at the close of the year reopening of some of the mines was being considered. Smelter output increased 4 percent, necessitating an increase in imports of zinc concentrates. During 1936, 196,000 metric tons were imported. Imports of slab zinc declined from 37,000 to 31,800 tons.

Germany.—Despite heroic efforts to make Germany self-sufficient with respect to zinc supplies, there was no appreciable change in amount of net imports, which approximated 120,000 metric tons in 1935 and 1936. Smelter production rose 10 percent and contributed

a slightly higher percentage of the total consumption of 209,000 tons. The slight decline in imports of metal thus permitted was offset by larger imports of ore. Government subsidies have stimulated zinc mining, but the mine output in 1936 apparently was 50,000 tons short of smelter requirements.

The Magdeburg electrolytic zinc plant operated at capacity during 1936, and an increase in capacity from 40,000 to 60,000 tons per annum is under way. The new retort smelter at Oker (40,000 tons annual capacity) opened in the latter part of the year, and full-scale operation is expected before the end of 1937. Zinc is being substituted wherever possible for other metals for which Germany depends largely on imports.

India, British.—The Burma Corporation, Ltd., produced 76,807 long tons of zinc concentrates averaging nearly 58 percent zinc in 1936 compared with 78,590 tons of 57 percent grade in 1935. The concentrates were shipped largely to Europe. Imports of slab zinc, used largely in the manufacture of galvanized products, declined from 22,756 to 21,272 tons.

Italy.—Statistical details of the Italian industry for 1936 are not available, because publication of all official statistics was suspended in the middle of the year. Exports of zinc ore apparently increased, as Germany reported receipts of 17,000 metric tons in 1936 compared with only 2,000 tons in 1935, while Belgian receipts were unchanged at 17,000 tons. According to some reports, the Porto Marghera electrolytic zinc plant, when completed in 1937, will have capacity to produce 12,000 tons per year instead of the 6,000 originally planned.

Japan.—Apparent consumption of zinc in Japan in 1936 was 78,200 metric tons compared with 67,000 tons in 1935. Of the 1936 total, 54 percent was supplied by imported metal and approximately 31 percent by imported ores. Domestic mines, therefore, furnished only 15 percent of Japan's needs. Imports of metal totaled 42,000 tons, Canada, Australia, and the United States being the principal sources.

Mexico.—Mine production of zinc in 1936 totaled 150,250 metric tons compared with 135,921 tons in 1935. Smelter production is estimated at 40,000 tons, leaving approximately 110,000 tons avilable for export in the form of ore. Belgium reported receipts of 153,000 tons of Mexican ore in 1936, France 29,000 tons, Germany 21,000 tons, United Kingdom 2,500 tons, and the United States less than 200 tons.

Newfoundland.—Production of zinc concentrates decreased from 146,000 short tons in 1935 to 141,000 in 1936. In addition, over 46,000 tons of lead concentrates were produced in 1936. All of the zinc concentrates and the greater part of the lead concentrates are shipped to Europe for smelting.

Poland.—The increase in smelter output in 1936 was partly derived from larger imports of ore. Germany, formerly the principal foreign source of zinc ore smelted in Poland, supplied less than 8,000 metric tons of a total of 73,000 purchased abroad in 1936. The remainder was obtained from Rumania, Greece, and Italy. Exports of slab zinc amounted to 61,600 tons, of which Germany took about 27,000 tons. Giesche Spolka Akcyjna produced about 43,000 tons of zinc in 1936.

Spain.—Civil war in Spain evidently has not affected operations at the Reocin mine in northern Spain, as French imports from Spain were considerably higher in 1936 than in 1935. The Reocin ore goes to France for roasting and is then forwarded to Norway for con-

version into electrolytic zinc. The Norwegian plant operated at capacity throughout 1936. Zinc mining in southern Spain probably has declined considerably.

U. S. S. R. (Russia).—Zinc production increased further in 1936. Plans for a new smelter near Gloubokoie in the Altai district are reported to have been ratified, and at Kirovgrad in the Urals a plant is under construction that will treat annually 250,000 to 300,000 tons of copper slag containing 5 to 6 percent zinc. The U. S. S. R. is now virtually self-sustaining with regard to zinc.

United Kingdom.—The smelter output of zinc increased 3 percent in 1936. The industry is supported largely on foreign ores, imports of which decreased from 152,000 long tons in 1935 to 130,000 in 1936. The decline was mainly in shipments from Australia. As the local smelting industry is inadequate for the needs of the country, large imports of metal are required. Net imports were 174,000 tons in 1936 and 151,000 in 1935. Consumption increased 10 percent over 1935 and totaled 217,000 tons.

The Imperial Smelting Corporation, Ltd., the only zinc-smelting company in the United Kingdom, operated its new vertical-retort plant at Avonmouth at capacity throughout the year. In November the company announced that owing to losses sustained the Seaton Carew smelter had been shut down and that it also purposed closing the Bloxwich plant, which operates largely on scrap. The company was active during 1936 in promoting a renewal of the cartel but insisted that it should be given preferential treatment in the British market. Following the collapse of cartel negotiations in the latter part of the year, the company asked the Government for an increase in the import duty on zinc. Such action, however, would have been difficult in view of the Ottawa agreement. Under a recent trade treaty negotiated with Canada, the British Government is free to impose a tariff on Canadian zinc, on which British consumers depend to a great extent. With the rising market at the close of 1936 and early in 1937, immediate action in this respect seemed improbable. Early in 1937 it was rumored that the Government was acquiring large quantities of zinc.

Yugoslavia.—Trepca Mines, Ltd., treated 600,200 metric tons of ore in 1936, from which 78,100 tons of 50-percent zinc concentrates and 65,700 tons of 80-percent lead concentrates were obtained. The ore averaged about 7 percent zinc, 9 percent lead, and 3.2 ounces of silver per ton. The declining zinc content of the ore in the lower levels of the mine accounts for a 15-percent decline in the production of zinc concentrates. The zinc concentrates are shipped to Belgium and France for smelting. The operations of this company were described in detail in the September to December 1936 issues of Mining and Metallurgy.

LEAD AND ZINC PIGMENTS AND ZINC SALTS

By Elmer W. Pehrson and H. M. Meyer

SUMMARY OUTLINE

In consequence of the greater demand for paint, automobiles, pneumatic tires, and storage batteries—all major pigment-consuming industries—sales of lead and zinc pigments in 1936 increased 14 percent over 1935 in both value and tonnage. Compared with 1925–29 averages, however, sales were still 39 percent lower in value but only 12 percent lower in tonnage, indicating that prices have not improved to the same extent as production.

Salient statistics of the lead and zinc pigments industry of the United States, 1925–29 (average) and 1932–36

	1925–29 (average)	1932	1933	1934	1935	1936
Production (sales) of principal pigments:						
White lead (dry and in oil) short tons	154,483	66,674	72,982	78,734	96,831	118,407
Litharge do	84,845	58,096	61,193	68,733	79,930	86,246
Red lead do	41,362	18,880	21,988	26,743	28,776	34,896
Zinc oxide do	154,208	72,250	98,542	87,088	99,697	126,800
Leaded zinc oxide do	26,609	14,305	22,868	20,506	29,976	40,512
Lithopone do	177,745	121,667	140,831	145,565	159,486	158,319
Value of products:						
All lead pigments	$60,092,000	$19,133,000	$20,819,000	$24,002,000	$28,064,000	$34,206,000
All zinc pigments	41,314,000	19,430,000	24,143,000	24,106,000	26,500,000	27,862,000
Total	101,406,000	38,563,000	44,962,000	48,108,000	54,564,000	62,068,000
Value per ton received by producers:						
White lead (dry)	178	117	112	126	124	126
Litharge	176	89	101	103	104	116
Red Lead	193	111	120	123	121	133
Zinc oxide	133	110	105	113	103	90
Leaded zinc oxide	124	91	88	98	93	87
Lithopone	98	84	83	84	84	82
Foreign trade:						
Lead pigments:						
Value of exports	1,346,000	365,000	327,000	404,000	512,000	546,000
Value of imports	30,000	6,000	2,000	4,000	2,000	7,000
Zinc pigments:						
Value of exports	2,150,000	466,000	230,000	395,000	392,000	420,000
Value of imports	931,000	521,000	567,000	373,000	468,000	375,000
Export balance	2,535,000	304,000	[1] 12,000	422,000	434,000	584,000

[1] Import balance.

Lead pigments again fared better than zinc pigments. Total sales of lead pigments increased 22 percent in value and 16 percent in quantity whereas zinc pigments increased only 5 percent in total value and 13 percent in quantity. Producers of lead pigments received nearly $7 per ton more for their product in 1936 than in 1935, while zinc pigments brought $6 less per ton. Trends in lead pigment quotations during 1936 paralleled those of metallic lead, but prices of zinc pigments did not respond to the sharp increase in the zinc quotation. Prices of the zinc oxides, for instance, were increased only 0.25 cent per

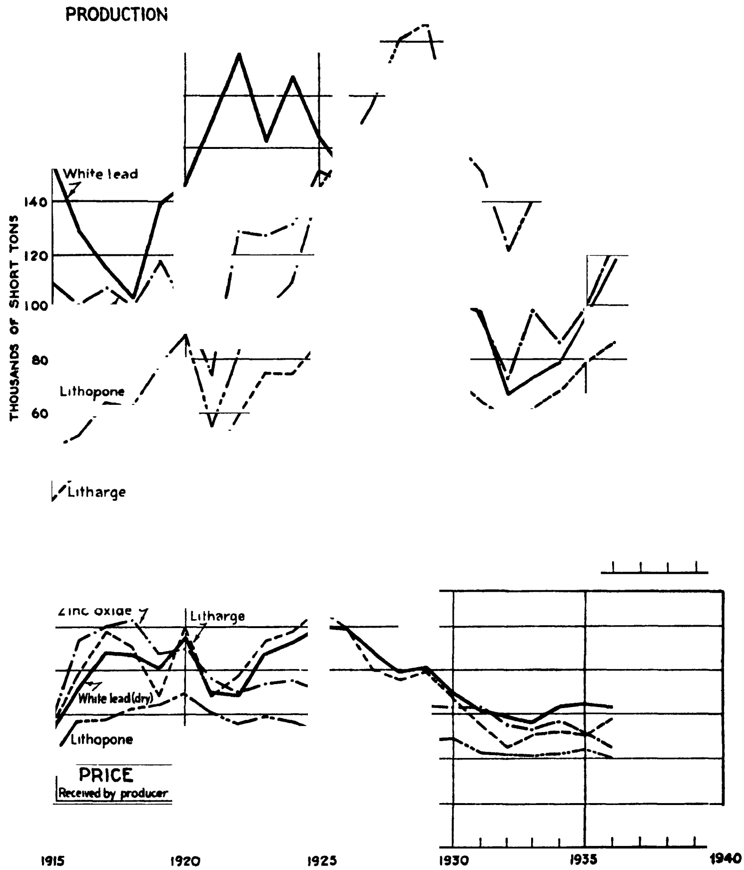


FIGURE 30.—Production and price trends of the principal lead and zinc pigments, 1915-36.

pound during 1936 whereas the price of metal rose 0.60 cent between January 1 and December 31. The lower sales realization on zinc pigments in 1936 resulted from the drastic cut in prices put into effect the latter part of 1935 and the 0.25-cent reduction in lithopone prices in November 1936. The latter was prompted by a 1-cent cut in the quotation for titanium dioxide.

Comparison of the sales of the white-lead pigments and zinc oxides to the paint trade in recent years reveals substantial gains in the use of leaded zinc oxide. In 1932, total sales amounted to 105,529 short tons, of which white and sublimed lead comprised 66 percent, zinc

oxide 21 percent, and leaded zinc oxide only 13 percent. By 1936 total sales bad increased to 194,762 tons, of which the lead pigments supplied 62 percent, zinc oxide 17 percent, and leaded zinc oxide 21 percent. For the same period the average lead content of the latter pigment increased from 23 to 27 percent and production nearly trebled.

Tyler[1] has pointed out the rapid increase in production of titanium pigments and their expanding use in fields formerly supplied exclusively by lead and zinc pigments. Much of this expansion has taken place during a period when prices of lead and zinc were extremely low. Even under these conditions titanium enjoyed a distinct advantage from the standpoint of low-cost raw materials, as ilmenite, the principal source of titanium, was considerably cheaper than lead and zinc ores. Recent sharp rises in lead and zinc prices, coupled with the fact that there has been no appreciable change in the cost of ilmenite, has favored the competitive position of titanium. In this connection the drop in the price of lithopone in 1936 in the face of a rising metal market was significant. Further increase in imports of ilmenite in 1936 suggests a record production of titanium pigments in that year.

PRODUCTION

In this report, sales of pigments and salts are considered to represent production, as no account is taken of the stocks on hand at the beginning and end of the year. The quantities used by producers at their own plants are included under sales.

The total value of lead and zinc pigments sold by domestic producers was approximately \$62,068,000 in 1936 compared with \$54,564,000 in 1935. The total value of all lead pigments sold was \$34,206,000 and that of all zinc pigments sold \$27,862,000. Sales of lead pigments increased 22 percent in total value and 16 percent in quantity, whereas sales of zinc pigments increased 5 percent in total value and 13 percent in quantity. The average value per ton of lead pigments sold in 1936, as reported by producers, increased only 5 percent, whereas the average New York quotation for pig lead increased 16 percent. Zinc pigments decreased 7 percent in value per ton compared with a 13-percent increase in the St. Louis quotation for slab zinc.

Lead pigments.—Production of all lead pigments except orange mineral, which declined only slightly, increased in 1936. Production of white lead increased 22 percent but was 39 percent below the peak of 1922. Production of litharge was 8 percent higher than in 1935 and nearly equaled the record output of 1929; and the output or red lead, which increased 21 percent in 1936, was 19 percent below that of 1929. Production of sublimed lead was 1 percent more than in 1935. Unit values of all lead pigments except white lead in oil increased in 1936.

[1] Tyler, Paul M., Trends in White-Pigment Consumption: Inf. Circ. 6881, Bureau of Mines, 1936, 15 pp.

Lead pigments sold by domestic manufacturers in the United States, 1935–36

Pigment	1935			1936		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Basic lead sulphate or sublimed lead:						
White	7,572	$727,004	$96	7,531	$863,268	$115
Blue	727	71,682	99	891	102,565	115
Red lead	28,776	3,492,141	121	34,896	4,657,322	133
Orange mineral	252	47,515	189	248	48,196	194
Litharge	79,930	8,286,339	104	86,246	9,966,563	116
White lead:						
Dry	27,972	3,481,988	124	34,775	4,367,337	126
In oil [1]	68,859	11,957,171	174	83,632	14,200,617	170

[1] Weight of white lead only but value of paste.

Lead pigments sold by domestic manufacturers in the United States, 1927–36, in short tons

Year	White lead		Basic lead sulphate or sublimed lead		Red lead	Orange mineral	Litharge
	Dry	In oil	White	Blue			
1927	38,669	119,026	13,482	1,061	39,073	709	81,655
1928	42,049	111,923	16,002	1,234	40,497	459	85,570
1929	42,159	104,872	15,580	1,234	43,021	678	87,916
1930	32,548	69,592	10,308	1,219	32,941	356	72,578
1931	30,922	66,446	8,790	896	25,853	282	63,890
1932	19,946	46,728	5,708	549	18,880	212	58,096
1933	24,628	48,354	7,320	625	21,988	231	61,193
1934	22,569	56,165	6,399	668	26,743	234	68,733
1935	27,972	68,859	7,572	727	28,776	252	79,930
1936	34,775	83,632	7,531	891	34,896	248	86,246

Zinc pigments and salts.—Production of zinc oxide and leaded zinc oxide increased 27 and 35 percent, respectively, in 1936, the output of the latter being the highest on record. The tonnage for lithopone represents a decline of 1 percent from 1935, due to a change in the method of compiling statistics. Formerly the combined weights of standard-grade and high-strength lithopone were reported as total sales. Beginning with 1936 the total will include sales of standard grade plus the standard-grade content of the high-strength product. This change reduces the tonnage by the excess quantity of zinc sulphide contained in high-strength lithopone. Production in 1936, compiled on a basis comparable to former years, would show a moderate increase in output over 1935. The Bureau of Mines is not at liberty to publish statistics on the new basis for past years.

The 1936 tonnages were equivalent to the following percentages of the 1929 outputs: Zinc oxide, 79; leaded zinc oxide, 149; and lithopone, 77. Unit values of the oxides decreased substantially in 1936, and that of lithopone was slightly lower.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1935–36

Pigment or salt	1935			1936		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Zinc oxide [1]	99,697	$10,237,953	$103	126,800	$11,376,323	$90
Leaded zinc oxide [1]	29,976	2,791,808	93	40,512	3,508,673	87
Lithopone	159,486	13,470,274	84	158,319	12,976,754	82
Zinc chloride, 50° B	(2)	(2)	(2)	(2)	(2)	(2)
Zinc sulphate	7,108	324,966	46	8,687	388,081	45

[1] Zinc oxide containing 5 percent or more lead is classed as leaded zinc oxide.
[2] Figures not available.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1927–36, in short tons

Year	Zinc oxide	Leaded zinc oxide	Lithopone	Zinc chloride (50° B.)	Zinc sulphate
1927	151,246	26,064	176,994	40,141	6,418
1928	160,904	24,223	200,468	45,669	4,733
1929	160,611	27,149	206,315	43,189	7,454
1930	119,142	17,279	164,065	29,043	6,249
1931	95,700	18,577	151,850	34,885	5,290
1932	72,250	14,305	121,667	23,524	4,252
1933	98,542	22,868	140,831	32,187	5,698
1934	87,088	20,506	145,565	19,614	6,783
1935	99,697	29,976	159,486	(1)	7,108
1936	126,800	40,512	158,319	(1)	8,687

[1] Figures not available

CONSUMPTION BY INDUSTRIES

White lead.—About 95 percent of the white lead produced is used in the manufacture of paint. The tonnage used in this industry in 1936 was 24 percent above that in 1935, but 17 percent below that in 1929. Consumption of white lead in the ceramic industry increased 45 percent in 1936.

Distribution of white lead (dry and in oil) sales, 1929–36, by industries, in short tons

Industry	1929	1930	1931	1932	1933	1934	1935	1936
Paint	136,526	91,563	91,832	63,399	68,368	75,008	91,297	113,363
Ceramics	4,246	3,366	2,848	1,761	1,617	1,434	1,834	2,653
Other	6,259	7,211	2,688	1,514	2,997	2,292	3,700	2,391
	147,031	102,140	97,368	66,674	72,982	78,734	96,831	118,407

Basic lead sulphate.—This pigment is used largely in paint, and the quantity so used in 1936 was 5 percent above that in 1935 but 40 percent below that in 1929. In 1929 over 2,000 tons of basic lead sulphate were used in storage batteries, but this use has since dwindled. Large quantities of this pigment are used in leaded zinc oxide to increase the lead content. In 1936, approximately 2,400 tons were

used for this purpose by pigment producers reporting to the Bureau of Mines. This tonnage is not included in the accompanying statement of sales of basic lead sulphate but is included in figures shown for leaded zinc oxide. It is the Bureau's policy to measure production of a plant in terms of final products.

Distribution of basic lead sulphate sales, 1929–36, by industries, in short tons

Industry	1929	1930	1931	1932	1933	1934	1935	1936
Paints	13,435	9,573	8,311	5,689	7,072	6,611	7,770	8,124
Rubber	655	394	173	77	161	93	155	126
Storage batteries	2,327	1,104	697	195	99	139		28
Other	397	456	505	296	613	224	374	144
	16,814	11,527	9,686	6,257	7,945	7,067	8,299	8,422

Litharge.—The principal use of litharge is in the manufacture of storage batteries, but this outlet has been affected adversely by the growing tendency of battery makers to substitute a black oxide or suboxide of lead, which they manufacture themselves. This practice was begun in 1923, and by 1929 a total of 33,000 tons of the black oxide was being made. In 1936 one battery maker began the manufacture of litharge. In all, 40,832 tons of oxides were made at battery plants in 1936 compared with 34,146 tons in 1935. None of this is included in the Bureau of Mines statement of litharge production.

Distribution of litharge sales, 1929–36, by industries, in short tons

Industry	1929	1930	1931	1932	1933	1934	1935	1936
Storage batteries	37,160	33,173	31,605	29,365	27,327	30,024	36,067	38,700
Insecticides	(1)	6,000	7,508	11,735	11,126	12,271	14,665	14,662
Chrome pigments	8,112	3,286	3,582	2,591	3,973	6,162	7,356	8,407
Ceramics	8,663	4,089	4,124	2,963	5,438	6,696	6,751	7,762
Oil refining	13,615	12,028	7,351	4,793	6,070	7,614	7,869	7,259
Varnish	3,124	698	641	1,360	610	414	564	2,307
Rubber	6,651	4,736	3,032	1,921	2,875	2,466	3,171	2,147
Linoleum	322	388	208	169	106	104	280	280
Other	10,269	8,180	5,839	3,199	3,668	2,982	3,207	4,722
	87,916	72,578	63,890	58,096	61,193	68,733	79,930	86,246

[1] Included under "Other." Not separately reported.

Red lead.—The use of red lead in storage batteries and paints in 1936 increased 15 and 35 percent, respectively, over 1935. The quantity used in paints nearly equalled the amount used in 1929.

Distribution of red lead sales, 1929–36, by industries, in short tons

Industry	1929	1930	1931	1932	1933	1934	1935	1936
Storage batteries	25,689	18,998	13,700	10,655	12,949	15,987	17,657	20,323
Paints	11,855	10,906	9,256	6,389	7,182	8,766	8,721	11,786
Ceramics	903	835	811	467	715	595	867	807
Other	4,574	2,202	2,086	1,369	1,142	1,395	1,531	1,980
	43,021	32,941	25,853	18,880	21,988	26,743	28,776	34,896

Orange mineral.—Sales of orange mineral decreased slightly in 1936. This pigment is used chiefly in the manufacture of inks and color pigments, and the tonnage involved is quite small.

Distribution of orange mineral sales, 1929–36, by industries, in short tons

Industry	1929	1930	1931	1932	1933	1934	1935	1936
Color pigments	487	188	114	108	96	68	125	77
Ink manufacture	151	88	119	58	18	24	85	71
Other	40	80	49	46	117	142	42	100
	678	356	282	212	231	234	252	248

Zinc oxide.—Total sales of zinc oxide were 27 percent higher in 1936 than in 1935. All uses shared in the increase except floor coverings and textiles, which remained virtually unchanged from 1935. In the preparation of exterior paints, manufacturers are using smaller proportions of zinc oxide than formerly. Of the 1936 total, 42 percent was made by the French process and 58 percent by the American process, the same ratios as in 1935. The proportion of French-process oxide made from scrap zinc was virtually the same in 1936 as in 1935. Over 3,000 tons of zinc oxide, not included in the sales figures given herein, were used to make leaded zinc oxide in 1936. This tonnage is included under leaded zinc oxide.

Distribution of zinc oxide sales, 1931–36, by industries, in short tons

Industry	1931	1932	1933	1934	1935	1936
Rubber	47,972	37,679	53,869	50,145	57,734	72,885
Paints	31,357	22,369	29,218	23,741	25,289	33,149
Floor coverings and textiles	4,695	2,837	4,087	4,781	7,179	7,178
Ceramics	3,171	1,782	2,639	2,963	4,028	6,102
Other	8,505	7,583	8,729	5,458	5,467	7,486
	95,700	72,250	98,542	87,088	99,697	126,800

Leaded zinc oxide.—This pigment is used almost entirely in the manufacture of paint. The quantity sold for that purpose in 1936 was 36 percent more than in 1935. The present trend toward higher lead content in exterior paints is reflected in the large increase in use of leaded zinc oxide in 1935 and 1936. Some manufacturers now are marketing a 50-percent leaded zinc oxide. The tonnage stated under this heading includes approximately 2,400 tons of basic lead sulphate and over 3,000 tons of zinc oxide used by producers in the manufacture of leaded zinc oxide.

Distribution of leaded zinc oxide sales, 1931–36, by industries, in short tons

Industry	1931	1932	1933	1934	1935	1936
Paints	18,292	14,072	22,488	20,376	29,632	40,156
Rubber	38	26	46	28	36	32
Other	247	207	334	102	308	324
	18,577	14,305	22,868	20,506	29,976	40,512

Lithopone.—Sales of lithopone to the paint industry, as shown in the accompanying table, decreased slightly in 1936, but figures for the latter years are not comparable to those for previous years for reasons previously mentioned. Comparable figures would probably show a moderate increase in the use of regular and high-strength lithopone in

paint in 1936. The production of floor coverings and textiles rose appreciably in 1936. Of the total for that year approximately 6,800 tons were used in coated fabrics and textiles and the balance in linoleum and felt-base floor coverings. This distribution includes an estimate for one producer who was unable to segregate sales under these headings. Other items obtained in 1936 for which 1935 data are not available include paper, 1,629 tons, and ink, 321 tons. Lithopone production capacity was reported at 230,320 tons per year in both 1935 and 1936.

Lithopone is used extensively in interior paints, and in this field is now subject to intense competition from titanium pigments.

Distribution of lithopone sales, 1929–36, by industries, in short tons

Industry	1929	1930	1931	1932	1933	1934	1935	1936
Paints, etc.	150,804	126,076	119,446	93,465	106,995	114,472	124,615	122,461
Floor coverings and textiles	37,506	23,656	20,780	17,601	18,472	14,811	19,440	23,085
Rubber	7,176	5,997	5,833	3,955	5,078	4,596	4,435	4,908
Other	10,829	8,336	5,791	6,646	10,286	11,686	10,996	7,865
	206,315	164,065	151,850	121,667	140,831	145,565	159,486	158,319

Zinc sulphide.—Production of this pigment was reported by five plants in 1936; but owing to the fact that one producer represents such a large part of the total, the Bureau of Mines is unable to publish statistics. Most of the zinc sulphide is mixed with regular lithopone to make high-strength lithopone.

Zinc chloride.—The Bureau of Mines cannot report zinc chloride production because of the refusal of one of the large producers to supply reliable data.

According to the Department of Agriculture, the consumption of zinc chloride by wood-treating plants totaled 2,050 tons in 1936. From a peak of 26,000 tons (solid basis) in 1921, consumption of zinc chloride in this field declined to 1,600 tons in 1934. The loss of this market is due primarily to the fact that zinc chloride is soluble in water and therefore is not as effective as creosote, its principal competitor, in preserving wood exposed to moisture. From time to time various insoluble zinc preservatives have been developed, but none has found a wide market. Recently a chromated zinc was introduced, but enough time has not elapsed to gage its effect on this market for zinc.

Complete data on sales of zinc chloride in 1936 are not available, but returns received from producers representing roughly two-thirds of the total output indicate the following distribution of sales by uses in 1936:

	Percent		*Percent*
Soldering flux	24	Oil refining	5
Wood preserving	23	Others	10
Dry-cell batteries	25		
Vulcanized fiber	13		100

Zinc sulphate.—In 1935 and 1936 producers of zinc sulphate were asked to distribute their sales according to various industries. The results of the canvass are not very satisfactory because the distribution was incomplete. Producers selling large tonnages to jobbers were unable to classify sales of this type by consuming industries.

Of the total 1936 sales (8,687 tons), 4,201 tons were reported as sold to the rayon industry, 331 tons to electro-galvanizers, 339 tons to glue manufacturers, 124 tons to printers and dyers of textiles, and 113 tons to paint and varnish manufacturers; 3,579 tons were undistributed. A break-down of the latter figure would undoubtedly show much larger tonnages for the various uses enumerated. In 1935, 688 tons of zinc sulphate were used as a flotation reagent, according to data collected by T. H. Miller of the Bureau of Mines.

RAW MATERIALS USED IN THE MANUFACTURE OF LEAD AND ZINC PIGMENTS AND SALTS

Lead pigments and zinc pigments and salts are manufactured from a variety of materials, including ore, refined metal, and miscellaneous secondary materials, such as scrap and waste from various industrial processes. In 1936, 93.2 percent of the lead in lead pigments was derived from pig lead and 6.8 percent from ore. Only a few tons were derived from secondary material. The proportions for zinc pigments in 1936 were 63 percent from ore, 22 percent from slab zinc, and 15 percent from secondary materials.

Metal content of lead and zinc pigments produced by domestic manufacturers, 1935–36, by sources, in short tons

Source	1935		1936	
	Lead in pigments [1]	Zinc in pigments	Lead in pigments [1]	Zinc in pigments
Domestic ore	12,109	83,806	15,062	94,913
Metal	185,151	26,853	204,997	32,763
Secondary material [2]	144	21,358	37	22,834
	197,404	132,017	220,096	150,510

[1] Includes also lead recovered in zinc oxide and leaded zinc oxide.
[2] Zinc ashes, skimmings, drosses, and old metal.

In the following tables the source of the metal used in the manufacture of each pigment and salt is given. Pig lead is used exclusively, either directly or indirectly, in the manufacture of white lead, litharge, red lead, and orange mineral and to a large extent in the manufacture of basic lead sulphate. Zinc oxide is the only pigment in which considerable slab zinc is used. Ore is employed in the manufacture of zinc oxide, leaded zinc oxide, lithopone, zinc sulphate, and basic lead sulphate. Some secondary lead is used in the manufacture of basic lead sulphate, and a substantial proportion of the zinc in lithopone and zinc chloride made in the United States is derived from secondary material. There has been a large increase in the quantity of secondary zinc used in the manufacture of zinc oxide since 1933. This material has displaced slab zinc in the manufacture of the French-process oxide.

Lead content of lead and zinc pigments produced by domestic manufacturers, 1935–36, by sources, in short tons

Pigment	1935				1936			
	Lead in pigments produced from—			Total lead in pigments	Lead in pigments produced from—			Total lead in pigments
	Domestic ore	Pig lead	Secondary material		Domestic ore	Pig lead	Secondary material	
White lead		83, 079		83, 079		89, 779		89, 779
Red lead		25, 173		25, 173		31, 517		31, 517
Litharge		74, 724		74, 724		81, 883		81, 883
Orange mineral		296		296		249		249
Basic lead sulphate	4, 624	1, 879		6, 503	4, 699	1, 569		6, 268
Leaded zinc oxide	7, 484		144	7, 628	10, 363		37	10, 400
Zinc oxide	1			1				
	12, 109	185, 151	144	197, 404	15, 062	204, 997	37	220, 096

Zinc content of zinc pigments and salts produced by domestic manufacturers, 1935–36, by sources, in short tons

Pigment or salt	1935				1936			
	Zinc in pigments and salts produced from—			Total zinc in pigments and salts	Zinc in pigments and salts produced from—			Total zinc in pigments and salts
	Domestic ore	Slab zinc	Secondary material		Domestic ore	Slab zinc	Secondary material	
Zinc oxide	47, 021	26, 749	7, 490	81, 260	56, 946	32, 625	9, 201	98, 772
Leaded zinc oxide	16, 185	104	356	16, 645	19, 065	138	183	19, 386
Lithopone	[1] 20, 600		13, 512	[1] 34, 112	18, 902		13, 450	32, 352
Zinc sulphide	(1)			(1)	(2)		(2)	(2)
Zinc chloride	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Zinc sulphate	1, 966		483	2, 449	1, 078		1, 224	2, 302

[1] Zinc content of a small quantity of zinc sulphide included with zinc content of lithopone.
[2] Figures not available.

PRICES

The total value and the average price received by producers from sales of lead and zinc pigments and salts are stated earlier in this chapter. The range of market quotations, as reported by the Oil, Paint, and Drug Reporter, appears in the following table. Quotations on lead pigments were advanced as the price of lead moved upward during the latter part of 1936. On October 1, zinc oxide prices were advanced by one-fourth cent per pound but were still considerably out of line with the price of the metal. A drop of 1 cent per pound in the price of titanium dioxide on November 2 was followed shortly by a reduction of one-fourth cent per pound in lithopone prices and 1½- to 2¼-cent cuts in zinc sulphide quotations.

Range of quotations on lead pigments and zinc pigments and salts at New York (or delivered in the East), 1933–36, in cents per pound

Product	1933	1934	1935	1936
Basic lead sulphate, or sublimed lead, less than carlots, barrels	5.50– 6.00	6.25	6.25	6.25– 6.75
White lead, or basic lead carbonate, dry, carlots, barrels	6.00– 6.50	6.25– 6.50	6.50	6.50– 7.25
Litharge, commercial, powdered, barrels	5.50– 7.00	6.00– 6.75	6.00– 7.00	6.00– 8.50
Red lead, dry, 95 percent or less, less than carlots, barrels	6.50– 8.00	7.00– 7.75	7.00– 8.00	7.50– 9.50
Orange mineral, American, small lots, barrels:				
Ex-white lead	10.25–11.75	10.75–11.50	9.50–11.00	10.50–11.25
Ex-red lead	9.00–10.50	9.50–10.25	9.00–10.50	10.50–11.25
Zinc oxide:				
American process, lead-free, bags, car lots	5.75	5.75– 6.50	5.00– 6.50	5.00– 5.25
American process, 5 to 35 percent lead, barrels, carlots	5.75	5.75– 6.50	5.13– 6.50	5.13– 5.38
French process, red seal, bags, carlots	8.63	8.38	5.50– 8.38	5.50– 5.75
French process, green seal, bags, carlots	9.63	9.38	6.00– 9.38	6.00– 6.25
French process, white seal, barrels, carlots	10.88	10.63	6.50–10.63	6.50– 6.75
Lithopone, domestic, 5-ton lots, bags	4.50	4.50	4.50	4.25– 4.50
Zinc sulphide, less than carlots, bags, barrels	13.00–13.50	10.50–13.25	10.50–11.75	9.25–11.75
Zinc chloride, works:				
Solution, tanks	2.00– 3.00	2.00	2.00	2.00
Fused, drums	4.25– 5.75	4.25– 5.75	4.50– 5.75	4.25– 5.75
Zinc sulphate, crystals, barrels	2.75– 3.75	2.65– 4.50	2.65– 2.80	2.65– 3.95

FOREIGN TRADE [2]

Imports of lead and zinc pigments and salts declined 16 percent and exports increased 3 percent in 1936. The export surplus increased from $452,000 to $572,000; in 1929 it was over $3,000,000. In 1933 there was an apparent import surplus.

The following table shows the value of the various pigments and salts imported and exported for 1935–36.

Value of foreign trade of the United States in lead and zinc pigments and salts, 1935–36

	1935		1936	
	Imports	Exports	Imports	Exports
Lead pigments:				
White lead	$1,153	$277,583	$5,443	$265,685
Red lead	109	98,727	201	113,897
Litharge		135,976	51	166,093
Orange mineral	368	(1)	911	(1)
Other lead pigments	478	(1)	28	(1)
	2,108	512,286	6,634	545,675
Zinc pigments:				
Zinc oxide	205,264	170,757	92,112	190,045
Lithopone	256,731	221,611	273,571	229,942
Zinc sulphide	6,073		9,190	(1)
	468,068	392,368	374,873	419,987
Lead and zinc salts:				
Lead arsenate		94,448		64,215
Other lead compounds	36,120		25,980	(1)
Zinc chloride	34,027		33,368	(1)
Zinc sulphate	6,381		17,252	(1)
	76,528	94,448	76,600	64,215
Grand total	546,704	999,102	458,107	1,029,877

[1] Figures not available.

[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Lead pigments and salts.—Imports of these commodities are of negligible proportions. The most important item is the group of lead compounds, including lead acetate, lead nitrate, and others.

Lead pigments and salts imported for consumption in the United States, 1932–36, in short tons

Year	Basic carbonate white lead	Red lead	Litharge	Orange mineral	Lead compounds	Total value
1932	29	4		4	277	$52,865
1933	3	1		10	268	39,312
1934	15		(1)	5	183	29,368
1935	6	1		2	302	[2] 38,228
1936	32	1	(1)	5	185	[2] 32,614

[1] Less than 1 ton.
[2] Includes also—1935: Lead pigments, n. s. p. f., $478 (4,405 pounds); 1936: Lead pigments, n. s. p. f. $19 (33 pounds) and sublimed lead (basic sulphate) $9 (15 pounds).

The principal exports are white lead, litharge, red lead, and lead arsenate. Less than 3 percent of the domestic production of white lead, red lead, and litharge was exported in 1936.

Lead pigments and salts exported from the United States, 1932–36, in short tons

Year	White lead	Red lead [1]	Litharge	Lead arsenate	Other lead compounds	Total value
1932	1,681	493	1,493	595		$461,694
1933	1,048	570	1,538	299		371,769
1934	1,561	745	972	325		457,273
1935	2,337	750	1,280	578		606,734
1936	1,861	810	1,386	414		609,890

[1] Includes an unknown quantity of orange mineral, 1932–33.

White lead and red lead, orange mineral,[1] and litharge exported from the United States, by destinations, 1933–36, in short tons

Destination	White lead				Red lead, orange mineral,[1] and litharge			
	1933	1934	1935	1936	1933	1934	1935	1936
Countries:								
Argentina	60	69	98	126	109	232	162	139
Canada	75	91	56	74	1,104	415	502	544
Netherlands	377	463	827	387			2	43
Netherland West Indies	2	10	3	3	58	(2)	81	274
Panama	26	201	205	453	68	112	52	53
Philippine Islands	138	130	190	170	164	210	287	342
United Kingdom	73	47	93	13	17	3	2	17
Others	296	550	865	635	588	745	942	784
	1,047	1,561	2,337	1,861	2,108	1,717	2,030	2,196
Continents:								
North America	223	477	441	754	1,404	759	930	1,140
South America	150	177	202	218	210	346	402	344
Europe	479	590	1,242	707	213	232	139	219
Asia	141	(2)	285	172	201	40	335	407
Africa	53	167	166	9	80	118	224	62
Oceania	1	150	1	1	(2)	222	(2)	24

[1] Orange mineral is not included in this group in 1934–36. Data not available.
[2] Less than 1 ton.

Zinc pigments and salts.—Imports of lithopone increased in 1936 and were approximately twice as large as exports. Net imports amounted to less than 2 percent of domestic production.

Zinc pigments and salts imported for consumption in the United States, 1932–36, in short tons

Year	Zinc oxide		Lithopone	Zinc sulphide	Zinc chloride	Zinc sulphate	Total value
	Dry	In oil					
1932	2,515	157	4,724	33	251	131	$539,380
1933	2,359	182	5,596	27	431	193	600,474
1934	1,204	64	3,927	12	382	140	404,256
1935	1,931	59	4,603	15	564	135	508,476
1936	693	96	4,780	29	519	380	425,493

Exports of zinc oxide and lithopone increased slightly in 1936. Most of this trade is with North American countries, chiefly Canada.

Zinc pigments and salts exported from the United States, 1932–36, in short tons

Year	Zinc oxide	Lithopone	Zinc salts	Total value	Year	Zinc oxide	Lithopone	Zinc salts	Total value
1932	1,261	3,212	299	$512,559	1935	1,140	2,371	(1)	$392,368
1933	722	1,186	(1)	230,024	1936	1,330	2,538	(1)	419,987
1934	1,155	2,401	(1)	395,189					

[1] Zinc salts not separately recorded.

Zinc oxide and lithopone exported from the United States, by destinations, 1933–36, in short tons

Destination	Zinc oxide				Lithopone			
	1933	1934	1935	1936	1933	1934	1935	1936
Countries:								
Argentina	16	36	35	55	12	33	74	35
Canada	286	439	453	704	881	1,803	1,652	1,812
Cuba	22	87	115	80	41	185	198	186
France	5	12	15	13		1	2	3
United Kingdom	36	68	56	80	132	104	138	199
Others	357	513	466	398	120	275	307	303
	722	1,155	1,140	1,330	1,186	2,401	2,371	2,538
Continents:								
North America	437	856	724	879	975	2,046	1,970	2,103
South America	39	48	78	131	54	116	118	57
Europe	72	66	94	97	133	125	140	219
Asia	80	41	132	51	3	1	15	25
Africa	3	12	5	6	1		2	4
Oceania	91	132	107	166	20	113	126	130

GOLD, SILVER, COPPER, AND LEAD IN ALASKA

(MINE REPORT)

By Chas. W. Henderson

SUMMARY OUTLINE

The total output of gold, silver, copper, and lead from Alaska ores and gravels in 1936, in terms of recovered and estimated recoverable metals, was 539,162.60 fine ounces of gold, 427,592 fine ounces of silver, 29,166,000 pounds of copper, and 1,882,000 pounds of lead. This output compares with a production of 469,495.00 ounces of gold, 286,848 ounces of silver, 15,500,000 pounds of copper, and 1,340,000 pounds of lead in 1935.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the prices given in the table that follows. Gold in 1932 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1837, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95 per ounce, the yearly average weighted United States Government price[1]; and in 1935 and 1936 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1932 and 1933 is the average New York price for bar silver; in 1934, the Treasury buying price ($0.64646464+ per ounce) for newly mined silver; and in 1935 and 1936, the yearly average weighted Treasury buying price for newly mined silver. The copper, lead, and zinc prices are weighted yearly averages of all grades of primary metal sold by producers.

Prices of gold, silver, copper, lead, and zinc, 1932–36

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[1] $20.67+	$0.282	$0.063	$0.030	$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050

[1] $20.671835. [2] $0.64646464.

[1] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Mine production of gold, silver, copper, and lead in Alaska, 1934–36, in terms of recovered metals

Year	Gold (lode and placer)		Silver (lode and placer)		Copper		Lead		Total value
	Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	
1934	537,281.83	$18,778,000	168,868	$109,167	114,000	$9,120	1,493,000	$55,241	$18,951,528
1935	469,495.00	16,432,325	286,848	206,172	15,500,000	1,286,500	1,340,000	53,600	17,978,597
1936	539,162.60	18,870,691	427,592	331,170	29,166,000	2,683,272	1,882,000	86,572	21,971,705

MARKETS AND SHIPPERS

There are no smelters or refineries in Alaska. The bulk of the gold produced in 1936 was in the form of bullion from placer and lode mines sent to United States mints and assay offices. The bulk of the silver was contained in concentrates and high-grade ore shipped to the Selby (Calif.) and Tacoma (Wash.) smelters. Because of the transportation cost, all concentrates are high-grade.

Most of the copper in 1936 was contained in copper-silver ore and concentrates from the Kennecott Copper Corporation and Mother Lode Coalition Mines Co. at Kennecott. Other contributors of copper (as copper-gold-silver concentrates) were the Alaska Gold & Metals Co. at Ketchikan and the Nabesna Mining Co. at Chitina. The bulk of the lead production in 1936 was contained in lead-silver-gold concentrates from the Alaska Juneau Gold Mining Co. amalgamation-concentration mill at Juneau. Small tonnages of gold-silver concentrate were shipped by the Alaska Empire Gold Mining Co., Hawks Inlet; Chichagoff Mining Co., Chichagof; Golden Horn Mining Co., Iditarod; Gold Cord Development Co., Wasilla; Gold Helm Mining Co., Ketchikan; Fern Gold Leasing Co., Wasilla; Gold Standard Mines, Helm Bay; Hirst-Chichagoff Mining Co., Kimshan Cove; and Nukalaska Mining Co., Seward.

The total receipts from Alaska at the San Francisco Mint during 1936 were 8,900 fine ounces of gold and 1,362 fine ounces of silver, a large part of which came from C. J. Berry Dredging Co., Miller House district, and J. R. Murphy, lessee of the dredge (3-cubic foot buckets) of the Fairbanks Gold Dredging Corporation, Ltd., at Fairbanks; other large depositors were the Felder & Gale dredge (27 2½-cubic foot buckets) on Yankee Creek 16 miles from Takotna, and the H. J. Haney Mining Co. on Jerome Creek. The United States Smelting, Refining & Mining Co., Midvale, Utah, received a small amount of bullion from its subsidiary, the Fairbanks Exploration Co.; the Seattle Assay Office received the bulk of the bullion from this company.

The United States Assay Office, Seattle, Wash., reports the following receipts from Alaska in 1936:

Bullion of Alaskan origin deposited at United States Assay Office, Seattle, Wash., during year ended Dec. 31, 1936, in fine ounces

District	Gold	Silver	District	Gold	Silver
Circle	4,349.571	571.24	Kuskokwim	7,897.297	824.06
Cook Inlet	28,209.271	2,817.12	Nome	89,138.045	10,043.61
Copper River	7,016.413	2,075.13	Southeastern Alaska	142,204.996	25,125.32
Eagle	5,847.149	1,050.72	Tanana	167,655.884	23,068.97
Iditarod	28,111.124	4,246.05			
Koyukuk	1,476.018	131.06		481,905.768	69,953.28

Important shippers of bullion to the Seattle Assay Office in 1936 were: Alaska Empire Gold Mining Co. (Juneau), Alaska Juneau Gold Mining Co. (Juneau), Chichagoff Mining Co. (Chichagof), and Hirst-Chichagoff Mining Co., Kimshan Cove, all located in Southeastern Alaska; Alaska Gold Dredging Corporation (Dawson), American Creek Operating Co. (Fairbanks), Gold Placers, Inc. (Fairbanks), Ganes Creek Dredging Co. (Ophir), Nabesna Mining Co. (Chitina), Olson & Co. (Flat), Fairbanks Exploration Co. (Fairbanks), and the Walker's Fork Gold Corporation (Walker's Fork), all in the Yukon Basin region; Hammon Consolidated Gold Fields (Nome), in the Seward Peninsula region; Arctic Circle Exploration Co. (Candle), in the Kenai Peninsula region; Cripple Creek Mining Co. (Anchorage), Fern Gold Leasing Co. (Wasilla), and Willow Creek Mines, Inc. (Luckyshot), all in the Cook Inlet-Susitna region; and the Chititu Mines (McCarthy), in the Copper River region. The Miners & Merchants Bank of Iditarod at Flat was agent for large quantities of bullion from the Iditarod district, Yukon Basin region. The Miners & Merchants Bank of Alaska at Nome bought large quantities of gold from the Nome, Bluff, Candle, Council, Inmachuk, Kougarok, Haycock, Teller, Solomon, and Bonanza districts, all in the Yukon Basin and Seward Peninsula regions. Other bullion buyers who served their respective regions were: Bank of Seward, Seward Peninsula region; First National Bank of Cordova and First National Bank of Valdez, Cook Inlet-Susitna region; and First National Bank of Fairbanks, Yukon Basin region. Several smaller bullion buyers, scattered throughout the different mining regions, purchased small lots and in turn sold the bullion to the larger buyers.

The Willow Creek Mines, Inc., was a regular shipper of bars throughout 1936 from its Lucky Shot mine on Craigie Creek in the Willow Creek district at the head of Cook Inlet, in the Cook Inlet-Susitna region.

The Alaska Gold & Metals Co. continued to produce palladium in 1936 with its gold-silver-copper concentrates.

The bullion produced by 38 floating dredges located almost entirely in two regions, the Seward Peninsula and Yukon River Basin, constituted 47 percent of the Alaska gold production for 1936. The operation of these dredges is limited to 4 to 8 months of actual mining during the late spring, summer, and early fall months. The sources of this production are bench, river, and beach deposits.

Compared with the dredge output the production of gold from the lode mines is second in importance. While the lode mines are scattered throughout the entire Territory, the principal producers are located in the Southeastern Alaska region, Cook Inlet-Susitna region, and Yukon Basin region. The production from the lode mines is, for the most part, continuous throughout the year.

The total gold production from dragline scraper, hydraulic, and many small sluicing operations represents 18 percent of the Territory's total but is the most widespread geographically.

Of the silver production, 86 percent was contained in the copper-silver ore and concentrates from the Kennecott Copper Corporation in the Copper River region and as a byproduct in the bullion and concentrates produced by the Alaska Juneau Gold Mining Co. in Southeastern Alaska. The remainder was a byproduct of lode and placer gold bullion.

The Kuskokwim River region has produced much platinum, most of it from the operations of the Goodnews Bay Mining Co., located in the Goodnews Bay mining district of this region. Other small amounts of platinum have been produced from the small placer operations.

The production of the rarer metals of the platinum-iridium group was small in 1936 and confined mostly to the placer and lode mines of the Kuskokwim River region and Southeastern Alaska.

COMPANY REPORTS

The Thirty-First Annual Report of the United States Smelting, Refining & Mining Co. for the year ended December 31, 1936, contains the following comments on its Alaska operations.

At Fairbanks, Alaska, dredging operations started on March 20th, with all five of the dredges in operation by March 27th. Aggregate number of dredge days was 1,252 in 1936, compared with 1,268 in 1935. Grade was slightly lower; but an increase in the yardage handled resulted in higher gold output. A normal water supply for the season permitted the required stripping and thawing ahead of the dredges. The additional power unit to provide power for the equipment, preparation and handling of the newly acquired dredging areas, referred to in last year's report, was completed during the year; and good progress has been made in the preparation of these areas. Further proven gravel reserves were acquired during the year.

Weather conditions at Nome, Alaska, permitted an earlier start than in 1935, one of the dredges starting on May 17th, another on May 21st and the last one on June 19th. Aggregate number of dredge days was 515 compared with 449 for the previous season. Considerably more gravel was dredged; and with grade about the same, the gold output was materially increased.

The Twenty-Second Annual Report of the Alaska Juneau Gold Mining Co. for the year ended December 31, 1936 (dated Mar. 3, 1937), says—

The operating profit for the year 1936, before deductions for depreciation and Federal income tax, was $2,640,085.03. The substantial increase in operating profits over those of the previous year was due in greater part to an increase in yield of 8¢ per ton trammed, and in lesser part to an increased tonnage output. In 1935 the tonnage production suffered by time lost through a strike, and the increase in tonnage production in 1936 is due more to that fact than to a small increase in the rate of production per day of actual operation.

Three new stopes were completed and brought into production during the year, two in the North Orebody above Gold Creek Tunnel level, and one in the Perseverance area. The South Orebody stopes are now relieved from carrying the burden of production through the winter months under weather conditions that have been becoming more adverse in their effects each winter.

The two stopes located in the North Orebody area are continuations of other stopes in that area and the grade of ore to be mined here is well established. The grade of ore produced so far from the Perseverance stope is somewhat less than the average grade of South Orebody ore, all in accordance with expectations. The second stope in the Perseverance area will be brought into production this coming fall.

To continue the program for prospecting the lower levels of the mine, the No. 53 Prospect Winze has been sunk to a point 1,518 feet below the Gold Creek Tunnel level. A station has been cut at the No. 13 level and crosscutting through the ore horizon will be started this year.

A drainage tunnel was started and is being driven below and parallel to Gold Creek Tunnel, for the purpose of handling the water that comes into the mine in increasing amounts each year, through the South Orebody stopes, which have long since caved through to the surface.

Although gold production is expected to continue at about the 1936 yearly rate, increased taxation, Territorial, State and Federal, together with increasing prices of commodities, will have a tendency to effect a reduction in the amount of surplus earnings over and above the present dividend rate.

The work of developing and preparing the Perseverance section for mining was continued throughout the year. No. 470 stope, the first stope in this section, started 65 feet above the No. 4 main Gold Creek Tunnel level. Thirty-one thousand eighty-seven square feet of stope cutout was done, and the stope was in production at the end of the year. In addition, 745 feet of main haulage level, 722 feet of main oreways, together with 7,752 feet of auxiliary raises and intermediate levels, were driven. Several pieces of this work made connections with old Perseverance levels that are still open, thereby providing excellent ventilation for this area.

In the 53 winze area of the North Orebody the usual preparatory work was done both above and below the No. 4 level, and in addition the 53 winze, which has a slope of 60° from the horizontal, was sunk an additional 432 feet to a vertical depth of 1,518 feet below the main haulage level.

A station was cut in the winze and crosscutting was started on the 13 level, 450 feet below the previous lowest level, and 1,450 feet vertically below the main haulage level.

During the year, 193,100 pounds of powder were used in blasting powder drifts and 104,000 pounds were used in blasting long hole drill stations, making a total of 297,100 pounds for primary breaking, or 0.07 pound per ton trammed. The total powder consumption for mining was 0.30 pound per ton trammed as against 0.32 pound in 1935, and 0.28 pound in 1934.

Mill.—Experimental work, mentioned in last year's report having shown that a profit could be made by fine grinding and treating by flotation a certain portion of the fine tailings, was expanded into a regular part of mill operation. Five hundred tons of the coarser portion of the fine tailings are reground daily and treated by flotation, resulting in an additional profit of $50,000.00 during 1936 from this source. Further experimental work to recover values from the mill slimes is now under way. Results do not as yet justify a prediction as to whether this can be profitably done. Experimental work along this line will be continued and if profitable results are proved, appropriate installations of equipment will be made.

Labor.—There was an abundant supply of labor of all kinds throughout the year. The labor turnover during the year was very small. The six day work week adopted in 1934 has been continuously in effect since that time. The average daily wage for the year was $6.15 and the overall cost per man per day was $10.04.

Power plants.—The work of rebuilding the 2-mile flume and the rehabilitation of Salmon Creek No. 1 power plant was completed during the year. The rehabilitation of the plant has taken two seasons' work, the total cost having been $130,000.00. The plant was put in operation at the beginning of the 1936–37 winter season. The additional power supplied by this plant will make it unnecessary to run the steam plant except for a short time during peak loads in the longest, coldest winters or when line trouble on the mountain prevents transmission of power from the Annex Creek plant.

The small wooden dam at the Annex Creek Reservoir was rebuilt and an additional 5 feet was added to its height, giving additional storage for water equivalent to 1 million kilowatt-hours of power.

Gold content of ore from Alaska Juneau mine in 1936, by months

Month	Rock to mill from mine (tons)		Gold (ounce)				
			Recovery per ton fine-milled		Losses per ton of tailings		Content of rock from mine to mill
	Ore fine-milled	Coarse tailings rejected	In bullion	In galena concentrates	Fine	Coarse	
January	205,295	159,705	0.0546	0.0033	0.0096	0.0072	0.0411
February	184,000	148,170	.0491	.0035	.0095	.0072	.0376
March	201,859	167,981	.0569	.0050	.0096	.0072	.0424
April	202,424	155,126	.0511	.0042	.0088	.0068	.03923
May	224,206	152,174	.0483	.0054	.0078	.0063	.0392
June	216,006	155,324	.0509	.0072	.0083	.0066	.0414
July	212,718	161,182	.0573	.0070	.0087	.0068	.0445
August	210,542	167,548	.0613	.0070	.0082	.0065	.0454
September	208,631	157,369	.0514	.0072	.0090	.0069	.0415
October	211,882	157,658	.0556	.0071	.0091	.0070	.0442
November	209,470	155,460	.0568	.0072	.0088	.0068	.0447
December	175,013	167,057	.0596	.0073	.0093	.0071	.0424
Total and average	2,462,046	1,904,754	.0544	.0061	.0089	.0069	.0422

Gold content of ore from Alaska Juneau mine, 1893–1936

Year	Rock to mill from mine (tons)		Gold (ounce)				
			Recovery per ton fine-milled		Losses per ton of tailings		Content of rock from mine to mill
	Ore fine-milled	Coarse tailings rejected	In bullion	In galena concentrates	Fine	Coarse	
1893–1913	330, 278	176, 976	0. 1035	0. 0097	0. 0194	0. 0073	0. 0827
1914	60, 026	2, 410	. 0445	. 0087	. 0131	. 0077	. 0639
1915	179, 892		. 0353	. 0145	. 0145		. 0643
1916	180, 113		. 0227	. 0068	. 0145		. 0454
1917	677, 410		. 0164	. 0150	. 0111		. 0416
1918	574, 285	17, 933	. 0281	. 0082	. 0092	. 0073	. 0445
1919	616, 302	76, 593	. 0310	. 0087	. 0135	. 0092	. 0479
1920	637, 321	305, 549	. 0440	. 0121	. 0164	. 0106	. 0522
1921	904, 323	709, 277	. 0421	. 0097	. 0145	. 0097	. 0416
1922	1, 108, 559	1, 201, 991	. 0440	. 0116	. 0145	. 0097	. 0392
1923	1, 134, 759	1, 341, 481	. 0498	. 0111	. 0140	. 0092	. 0392
1924	1, 367, 528	1, 700, 662	. 0532	. 0140	. 0145	. 0097	. 0421
1925	1, 537, 884	1, 943, 896	. 0493	. 0145	. 0160	. 0106	. 0411
1926	1, 649, 678	2, 180, 022	. 0440	. 0126	. 0145	. 0097	. 0362
1927	1, 839, 695	2, 428, 115	. 0469	. 0145	. 0135	. 0092	. 0372
1928	1, 795, 191	1, 922, 949	. 0648	. 0198	. 0155	. 0101	. 0537
1929	2, 020, 470	1, 815, 970	. 0624	. 0189	. 0135	. 0092	. 0542
1930	2, 066, 239	1, 858, 221	. 0581	. 0203	. 0135	. 0092	. 0532
1931	2, 298, 998	1, 863, 352	. 0604	. 0178	. 0131	. 0087	. 0542
1932	2, 414, 469	1, 587, 161	. 0493	. 0135	. 0116	. 0082	. 0484
1933	2, 466, 832	1, 619, 128	. 0498	. 0116	. 0116	. 0082	. 0474
1934	2, 387, 138	1, 915, 462	. 0503	. 0034	. 0116	. 0082	. 0402
1935	2, 091, 475	1, 638, 185	. 0533	. 0035	. 0108	. 0078	. 0413
1936	2, 462, 046	1, 904, 754	. 0544	. 0061	. 0089	. 0069	. 0422
Total and average	32, 800, 911	28, 210, 087	. 0513	. 0124	. 0130	. 0090	. 0454

Gold, silver, and lead recoveries from Alaska Juneau mine, 1893–1936

Year	Gold		Silver		Lead		Total value recovered
	Fine ounces	Value	Fine ounces	Value	Pounds	Value	
1893–1913	34, 239. 49	$707, 730. 15	(1)	(1)	(1)	(1)	$707, 730. 15
1914–15	12, 174. 90	251, 655. 27	6, 191. 63	$2, 889. 89	117, 031	$6, 781. 10	261, 326. 26
1916	5, 564. 70	115, 022. 32	2, 843. 86	2, 014. 75	61, 068	4, 341. 61	121, 378. 68
1917	20, 767. 41	429, 262. 38	12, 247. 71	10, 492. 53	296, 179	20, 910. 88	460, 665. 79
1918	20, 809. 10	430, 124. 00	11, 827. 84	11, 704. 47	273, 297	17, 616. 54	459, 445. 01
1919	24, 141. 34	499, 001. 55	16, 431. 24	19, 366. 95	359, 762	24, 345. 49	542, 713. 99
1920	35, 455. 72	732, 869. 71	23, 347. 57	23, 394. 66	487, 574	35, 125. 62	791, 389. 99
1921	46, 913. 53	969, 702. 73	40, 619. 27	40, 371. 39	550, 913	25, 176. 53	1, 035, 250. 65
1922	62, 707. 16	1, 296, 156. 95	49, 404. 56	49, 089. 86	687, 315	43, 432. 46	1, 388, 679. 27
1923	69, 046. 87	1, 427, 198. 78	41, 875. 96	32, 079. 58	755, 423	55, 495. 78	1, 514, 774. 14
1924	92, 277. 39	1, 907, 373. 55	63, 191. 25	42, 501. 72	1, 256, 857	105, 906. 62	2, 055, 781. 89
1925	98, 213. 22	2, 030, 067. 16	55, 971. 17	38, 672. 49	1, 288, 974	115, 644. 43	2, 184, 384. 08
1926	93, 422. 91	1, 931, 051. 65	52, 333. 59	31, 268. 69	1, 300, 915	105, 516. 26	2, 067, 836. 60
1927	112, 653. 11	2, 328, 539. 72	61, 232. 30	34, 695. 75	1, 513, 306	100, 026. 91	2, 463, 262. 38
1928	152, 046. 84	3, 142, 808. 12	77, 590. 94	45, 272. 35	2, 038, 655	127, 938. 52	3, 316, 018. 99
1929	164, 993. 15	3, 410, 408. 33	90, 635. 49	46, 964. 67	2, 501, 832	169, 874. 31	3, 627, 247. 31
1930	163, 312. 00	3, 375, 659. 01	97, 606. 71	35, 004. 12	2, 640, 771	141, 286. 90	3, 551, 950. 03
1931	179, 532. 04	3, 710, 927. 34	118, 508. 16	33, 452. 37	3, 309, 176	135, 459. 59	3, 879, 839. 30
1932	151, 578. 25	3, 133, 122. 39	94, 519. 21	25, 867. 31	2, 509, 263	77, 193. 36	3, 236, 183. 06
1933	150, 966. 84	3, 829, 044. 81	109, 482. 71	40, 488. 46	2, 299, 777	90, 632. 19	3, 960, 165. 46
1934	128, 015. 26	4, 465, 354. 31	86, 458. 27	53, 842. 93	1, 662, 894	63, 361. 73	4, 582, 558. 97
1935	118, 997. 83	4, 165, 784. 05	77, 787. 17	56, 265. 16	1, 455, 167	59, 061. 05	4, 281, 110. 26
1936	149, 235. 23	5, 223, 231. 16	101, 590. 59	78, 794. 94	2, 102, 594	98, 594. 68	5, 400, 620. 78
Total	2, 087, 064. 29	49, 512, 095. 44	1, 291, 697. 20	754, 495. 04	29, 468, 743	1, 623, 722. 56	51, 890, 313. 04

1 Lost in tailings.

The Kennecott Copper Corporation operated its Kennecott property and mill and the adjoining Mother Lode Coalition Mines Co. property part of the year 1936. The Twenty-Second Annual Report of the

Kennecott Copper Corporation for the year ended December 1936 does not divide the Alaska output from the Utah and Nevada production but reaffirms the belief "that operations will cease in not more than 2 years, due to inability to find new ore bodies."

The Eighteenth Annual Report of the Mother Lode Coalition Mines Co. for the year ended December 31, 1936 (dated Mar. 12, 1937), says—

Operations at the mine were continued on a curtailed basis during the first part of the year but as the demand for and price of copper increased output was gradually raised.

There were received for treatment at the Tacoma Smelter during the year 15,454,983 pounds of copper. Due to the maritime strike on the Pacific Coast no shipments of ore or concentrates could be made from Alaska during November and December. The gross amount realized from metal sales was $950,240.90. After the addition of miscellaneous income and the deduction of all costs, including taxes, the net income of the company, before depletion, amounted to $403,532.93. A cash distribution of 12½ cents per share was made to stockholders December 21, 1936.

As has been repeatedly pointed out to you in previous annual reports, while development and prospecting work has been carried on, except during those years when the mine was shut down, the results have been most unfavorable and disappointing and no new ore bodies of commercial grade have been disclosed during the past 13 years. In view of the consequent depletion of the company's ore reserves and the short life of the mine indicated as still remaining, it was believed advisable by the management to secure the services of an independent mining engineer to make a thorough examination of the company's property. Mr. L. A. Levensaler was engaged for this purpose and in September of last year he extensively examined the property, particularly with respect to the scope of development and prospecting work already done, the advisability of its continuance, and the extent of the ore reserves still remaining in the mine.

Mr. Levensaler's examination confirmed the reports of the company's own engineers. He has advised that a careful examination of the developed area of the mine revealed that no commercial ore remains except as backs of drifts, sill floors and pillars within the stoped section between the 1,000- and the 1,400-foot levels. Mr. Levensaler advised that after the reclamation of these blocks of ore the mine will necessarily have to be abandoned. He further advised that the remaining development possibilities of the mine are too weak to justify prospecting and should be dropped from consideration.

A complete recalculation of all the known ore reserves was made by the company's engineers in conjunction with Mr. Levensaler. It is estimated that there were remaining in the mine on January 1, 1937, 2,589 tons of high grade ore containing 1,605 tons of copper, and 65,743 tons of milling ore containing 7,639 tons of copper, a total of 68,332 tons of ore with a copper content of 9,244 tons, of which some 8,000 tons should be recovered after allowing for probable losses in concentration. There had been produced and were awaiting shipment to the smelter on January 1, 1937, 5,039 tons of ore and concentrates containing 2,714 tons of copper. In addition, there were on hand, refined and in process, unsold at the smelter, 5,223 tons of copper. Consequently, on January 1, 1937, based upon the above estimate of remaining ore, the total quantity of copper still to be sold amounted to about 16,000 tons.

All present indications point to the life of the mine being extremely limited. No further prospecting seems justified. Therefore it is obvious that after the extraction of the small tonnage of ore still remaining the mine will have to be abandoned. The ore still left will be extracted at a rate judged most economical and the company's copper sold as deemed to its best advantage.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN ARIZONA [1]

(MINE REPORT)

By C. N. Gerry and Paul Luff

SUMMARY OUTLINE

The value of the metal production of Arizona in 1936 ($56,116,940) increased nearly 51 percent over 1935, due to the large increase in the quantity of all metals and in the prices of silver, copper, lead, and zinc. Most of the increase in value resulted from production and sales of copper; Arizona retained its place as the leading copper producer of the United States. The chief reasons for the higher production in 1936 were the increased activity in the Warren district, Cochise County; Ajo district, Pima County; Verde district, Yavapai County; Globe district, Gila County; and San Francisco district, Mohave County.

Arizona contains several of the largest well-developed and well-equipped copper-silver-gold mines in the United States. Three mines of the Phelps Dodge Corporation (Copper Queen at Bisbee, United Verde at Jerome, and New Cornelia at Ajo) produced nearly half of the State gold production; these three mines and the Magma mine produced 73 percent of the silver output. The recoverable gold output from mines in Arizona in 1936 was 310,000 ounces, the largest for 1 year ever recorded in the State and 68,245 ounces more than in 1935. The average annual output for the last decade was 175,588 ounces. At $35 an ounce the value of the 1936 gold output was $10,850,000 compared with $8,461,411 in 1935.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the prices given in the table that follows. Gold in 1932 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1837, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95 per ounce, the yearly average weighted United States Government price [2]; and in 1935 and 1936 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1932 and 1933 is the average New York price for bar silver; in 1934, the Treasury buying price ($0.64646464+ per ounce) for newly mined silver; and in 1935 and 1936, the yearly average weighted Treasury buying price for

[1] Figures for 1936 are preliminary; detailed data with final revisions will be released later.

[2] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

newly mined silver. The copper, lead, and zinc prices are weighted yearly averages of all grades of primary metal sold by producers.

Prices of gold, silver, copper, lead, and zinc, 1932–36

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[1] $20.67+	$0.282	$0.063	$0.030	$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050

[1] $20.671835. [2] $0.64646464.

Mine production of gold, silver, copper, lead, and zinc in Arizona, 1932–36, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1932	341	179	4,414,579	66,789.67	$1,380,665	2,082,823	$587,356
1933	399	179	995,728	79,992.61	2,044,611	2,390,363	836,627
1934	747	867	3,270,242	167,024.12	5,837,493	4,448,474	2,875,781
1935	904	1,197	6,770,050	241,754.60	8,461,411	6,601,280	4,744,670
1936 [1]	(2)	(2)	12,800,000	310,000.00	10,850,000	8,125,100	6,292,890

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1932	182,491,825	$11,496,985	2,364,300	$70,929			$13,535,935
1933	114,041,781	7,298,674	3,442,540	127,374	11,024	$463	10,307,749
1934	178,082,213	14,246,577	6,877,216	254,457	1,810,279	77,842	23,292,150
1935	278,029,289	23,076,431	15,566,100	622,644	6,673,932	293,653	37,198,809
1936 [1]	409,200,000	37,646,400	20,275,000	932,650	7,900,000	395,000	56,116,940

[1] Subject to revision.
[2] Figures not yet available.

Gold and silver produced at placer mines in Arizona, 1931–35, in fine ounces, in terms of recovered metals [1]

Year	Sluicing		Dry-land dredges [2]		Dragline floating dredges		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1931	1,069.23	157					1,069.23	157
1932	3,479.76	454					3,479.76	454
1933	3,671.45	424	257.73	18	1,200.94	161	5,130.12	603
1934	4,066.45	669	431.81	33	2,484.00	336	6,982.26	1,038
1935	2,561.47	494			2,595.53	338	5,157.00	832

[1] 7,000 ounces of gold produced at placer mines in 1936; other figures not yet available.
[2] Dragline and power-shovel excavators with sluices or special amalgamators.

Gold.—The recoverable gold output from mines in Arizona increased from 241,754.60 fine ounces in 1935 to 310,000 fine ounces in 1936. Gold from lode mines in 1936 was approximately 303,000 ounces compared with 236,597.60 ounces in 1935, and 7,000 ounces of gold were recovered from placers compared with 5,157.00 ounces in 1935. One floating dredge, equipped with power shovels but no buckets, was operated on Lynx Creek in 1936 as in 1935. Large increases in the production of gold in 1936 were shown by the United Verde, New Cornelia, Copper Queen Branch of the Phelps Dodge Corporation, Tom Reed, Pilgrim (Pioneer), Gold Standard, Shattuck-Denn, Mammoth-St. Anthony, Hillside, Pioneer, Bi-Metal, and Gold Road mines. Eleven mines in Arizona produced more than 5,000 ounces of gold each in 1936—the Copper Queen Branch at Bisbee, United Verde Branch at Jerome, New Cornelia Branch at Ajo, Tom Reed at Oatman, Hillside near Hillside, Magma at Superior, Portland at Katherine, Pioneer near Chloride, Octave near Congress Junction, Montana Mines Operations at Ruby, and Mammoth-St. Anthony at Mammoth. Other mines that produced more than 4,000 ounces of gold each in 1936 were the Harbud, United Verde Extension, Amulet (Pioneer), Lynx Creek dredge, and Shattuck-Denn mines. The construction of a new mill of importance in gold recovery was completed at the Gold Road property of the United States Smelting, Refining & Mining Co. near Oatman.

Silver.—The recoverable silver output increased from 6,601,280 ounces in 1935 to about 8,125,100 ounces in 1936 and the value from $4,744,670 to $6,292,890, as the average price of silver rose from 71.875 cents an ounce in 1935 to 77.45 cents in 1936. The average annual output for the last 10 years has been 5,361,630 ounces. More than 73 percent of the total silver produced in Arizona in 1936 was recovered from copper ore, chiefly from the Copper Queen, United Verde, Magma, and New Cornelia mines; most of the remainder was recovered from lead-zinc ore and siliceous ores. The Copper Queen and United Verde mines of the Phelps Dodge Corporation produced more than 56 percent of the State's silver. Other large producers of silver were the Eagle-Picher, Magma, New Cornelia, Hillside, United Verde Extension, Tombstone, Reymert, Miami, Shattuck-Denn, Swastica, and Arizona Magma properties.

The Warren (Bisbee) district in Cochise County increased its production of silver from 2,654,731 ounces in 1935 to about 3,260,000 in 1936; the Verde district in Yavapai County, from 1,049,934 ounces to 1,675,000; and the Pioneer (Superior) district in Pinal County, from 802,944 ounces to 805,000. However, the output of silver from the Oro Blanco (Ruby) district in Santa Cruz County dropped from 670,944 to 630,000 ounces.

Copper.—The recoverable copper output in 1936 was 409,200,000 pounds, the largest output since 1930, when 576,190,607 pounds were produced, and slightly greater than in 1931, when the production was 401,344,909 pounds. The largest yearly production was in 1929 (830,628,411 pounds) and the next largest in 1918 (764,855,874 pounds). The increase in 1936 over 1935 was 131,170,711 pounds, and the value increased from $23,076,431 to $37,646,400. The copper smelters at Douglas, Clarkdale, and Superior continued operations during 1936, and the receipts of ore and concentrates were considerably more than in 1935. The smelter at Clemenceau operated intermittently, but the smelters at Clifton and Hayden remained idle. The

New Cornelia mine of the Phelps Dodge Corporation at Ajo was again the largest producer of copper in Arizona; it was followed by the United Verde mine at Jerome and the Copper Queen mine at Bisbee (both operated by the Phelps Dodge Corporation), the Inspiration mine at Inspiration, the Miami mine at Miami, and the Magma mine at Superior. These six properties produced approximately 387,600,000 pounds of copper (nearly 95 percent of the State total), and each produced more than 30,000,000 pounds of copper. Other large producers of copper were the United Verde Extension, Shattuck-Denn, and Bagdad properties. The entire output of copper from the United Verde mine came from steam-shovel operations in the open pit, as no attempt is being made at present to mine ore from the deep levels of the property.

The Globe (Inspiration-Miami) district was the chief copper-producing district in Arizona in 1936, as the output increased from 37,359,120 pounds in 1935 to 109,150,000 in 1936; the Ajo district, with an increased production, ranked second; the Verde district, with a greatly increased production, ranked third; the Warren (Bisbee) district, with a production of about 78,600,000 pounds, ranked fourth; and the Pioneer (Superior) district, with a production of 30,150,000 pounds, ranked fifth.

Lead.—The recoverable lead production in Arizona increased from 15,566,100 pounds in 1935 to 20,275,000 in 1936, the largest production since 1926, when 23,258,274 pounds were produced. The value of the lead output in 1936 was $932,650 compared with $622,644 in 1935. The large gain in the production of lead in Arizona in 1936 was due chiefly to the increase in shipments of lead ore from the "79" mine near Winkelman and the Shattuck-Denn mine at Bisbee and to the reopening of the Tennessee-Schuylkill lead-zinc mine at Chloride and the Trench and Flux lead-silver mines near Patagonia. The Eagle-Picher Mining & Smelting Co. in 1936 was again by far the largest producer of lead in Arizona; it was followed by the "79", Trench (Gold Canyon Mining Co.), Tennessee-Schuylkill, Shattuck-Denn, Tombstone (Bunker Hill property including Toughnut lease), Hillside, Flux, and Copper Queen mines. These nine properties produced 91 percent of the State output of lead.

Zinc.—In 1934 and 1935 nearly all the zinc produced in Arizona came from the Montana property of the Eagle-Picher Mining & Smelting Co. at Ruby, Santa Cruz County. In August 1936 the Tennessee-Schuylkill group at Chloride, Mohave County, was reopened, and in September the 150-ton flotation-concentration plant started treating lead-zinc ore. The output of recoverable zinc in Arizona in 1936 was about 7,900,000 pounds valued at $395,000, compared with 6,673,932 pounds valued at $293,653 in 1935. As usual, the Eagle-Picher Mining & Smelting Co. was the largest producer of lead and zinc in Arizona and ranked third in the production of silver. The company operated its 250-ton flotation-concentration plant continuously and treated more lead-zinc ore in 1936 than in 1935.

Ore.—The output of ore in Arizona in 1936 was approximately 12,800,000 tons, an increase of 6,029,950 tons over 1935. Copper ore increased from 6,011,755 to 11,880,000 tons, gold (ore and old tailings) and gold and silver ore from 578,405 to 705,000 tons, silver ore from 26,239 to 32,000 tons, lead ore from 16,749 to 29,000 tons, and lead-zinc ore from 129,772 to 155,000 tons. There were large increases in

the output of copper ore from the Globe (Miami-Inspiration), Ajo, Verde, and Warren districts and in gold ore from the San Francisco (Oatman and Portland), Old Hat (Mammoth), and McConnico districts, but the output of ore from the Katherine district decreased considerably. Virtually the entire output from the Vulture district in 1936 was old tailings (gold) from the Vulture property which increased from 34,661 to about 100,000 tons. The New Cornelia, Miami, Inspiration, United Verde, Copper Queen, and Magma mines were the chief producers of copper ore; the Tom Reed, Hillside, Harbud, Portland, New Year-Mohawk, Mammoth-St. Anthony, Pilgrim, Golden Turkey, and Octave mines were the chief producers of gold ore; the Reymert mine was the largest producer of silver ore; the Arizona Magma property was the largest producer of gold and silver ore; the "79" mine was the largest producer of lead ore; and the Eagle-Picher property was the largest producer of lead-zinc ore.

SUMMARY OF 1935

Final annual figures on mine production in Arizona in 1935 and detailed statistics on production by classes of ore, methods of recovery of metals, and mining districts, continuing the series published in recent years in the Statistical Appendix to Minerals Yearbook, are included in this chapter.

From 1903 to the end of 1935 mines in Arizona have produced 358,865,867 tons of ore, 5,930,896.91 fine ounces of gold, 153,915,125 fine ounces of silver, 14,506,097,660 pounds of copper, 377,995,472 pounds of lead, and 146,428,497 pounds of zinc.

Gold.—The output of gold in Arizona in 1935 was 241,754.60 fine ounces, more than double the output (167,024.12 ounces) in 1934. Gold recovered at placers amounted to 5,157.00 ounces (1,825.26 ounces less than in 1934) and accounted for more than 2 percent of the State total; most of the placer output resulted from operation of the floating dredge on Lynx Creek by the Lynx Creek Placer Mine Co. and other operations in Yavapai County.

Gold recovered from lode mines was 236,597.60 fine ounces, of which 112,783.79 ounces came from copper ore and 112,266.75 from siliceous ore, chiefly gold ore. In 1934 copper ore supplied 76,092.34 ounces and siliceous ore 77,949.51 ounces. Gold from bullion recovered by amalgamation or cyanidation increased from 36,828.30 ounces in 1934 to 43,815.72 in 1935; most of the increase came from Mohave County. The Copper Queen Branch of the Phelps Dodge Corporation was by far the largest producer of gold in Arizona in 1935; it was followed by the United Verde Branch at Jerome and the New Cornelia Branch at Ajo, both operated by the Phelps Dodge Corporation. Other large producers of gold were the Tom Reed at Oatman, Magma at Superior, Eagle-Picher at Ruby, and Hillside near Hillside. These seven properties produced 129,700 ounces of gold or nearly 54 percent of the total output of the State.

Silver.—The output of silver increased 48 percent over that in 1934, and most of it (69 percent) was recovered from copper ore; the remainder was recovered chiefly from siliceous ore and lead-zinc ore. Nearly 62 percent of the State output of silver in 1935 came from the Copper Queen Branch at Bisbee, United Verde at Jerome, Eagle-Picher at Ruby, Magma at Superior, New Cornelia at Ajo, United Verde Extension at Jerome, and the Hillside north of Hillside.

Copper.—The output of copper in Arizona was 278,029,289 pounds in 1935, compared with 178,082,213 pounds in 1934, an increase of 56 percent. Of the total copper produced in Arizona in 1935, 276,469,902 pounds were recovered from copper ore and 67 percent came from 3 mines operated by the Phelps Dodge Corporation. The largest producer of copper in Arizona in 1935 was the New Cornelia mine; it was followed by the Copper Queen, United Verde, Magma, Miami, and United Verde Extension mines. The total value of the metals recovered from copper ore and precipitates was $30,161,989—81 percent of the total value of the gold, silver, copper, lead, and zinc produced in the State.

Lead.—The output of lead in Arizona in 1935 was 15,566,100 pounds, more than double the output (6,877,216 pounds) in 1934. The large increase in 1935 was due chiefly to the increase in the production of lead-zinc ore from the Eagle-Picher property at Ruby and lead ore from the "79" mine near Hayden Junction. Nearly 61 percent of the total lead was recovered from lead-zinc ore, 30 percent from lead ore, and 7 percent from siliceous gold ore. The Eagle-Picher Mining & Smelting Co. was, as usual, the largest producer of lead in Arizona; it was followed by the "79", Tombstone (Bunker Hill), and Tombstone Extension properties.

Zinc.—The output of zinc in Arizona was 6,673,932 pounds in 1935, compared with 1,810,279 pounds in 1934; no zinc was produced in 1931 or 1932. Nearly all the zinc produced in 1935 was recovered from lead-zinc ore from the property of the Eagle-Picher Mining & Smelting Co. at Ruby, Santa Cruz County; a little zinc was produced from a property north of Kingman, Mohave County.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1935, by counties, in terms of recovered metals

County	Mines producing			Ore (short tons)	Gold						Silver					
					Lode		Placer		Total		Lode		Placer		Total	
	Lode	Placer	Total		Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Cochise	62	34	96	629, 689	61, 915. 20	$2, 167, 032	63. 60	$2, 226	61, 978. 80	$2, 169, 258	2, 946, 119	$2, 117, 523	32	$23	2, 946, 151	$2, 117, 546
Gila	44	17	61	1, 175, 769	1, 069. 60	37, 436	30. 00	1, 050	1, 099. 60	38, 486	79, 328	57, 017	7	5	79, 335	57, 022
Graham	2	1	3	4	4. 00	140	. 40	14	4. 40	154	185	133			185	133
Greenlee	5	36	41	844	497. 20	17, 402	69. 20	2, 422	566. 40	19, 824	15, 879	11, 413	32	23	15, 911	11, 436
Maricopa	59	73	132	58, 558	4, 817. 40	168, 609	133. 60	4, 676	4, 951. 00	173, 285	36, 345	26, 123	39	28	36, 384	26, 151
Mohave	139	20	159	183, 418	46, 755. 00	1, 636, 425	85. 00	2, 975	46, 840. 00	1, 639, 400	160, 743	115, 534	25	18	160, 768	115, 552
Pima	123	61	184	3, 152, 983	22, 522. 00	788, 270	121. 00	4, 235	22, 643. 00	792, 505	255, 449	183, 604	25	18	255, 474	183, 622
Pinal	62	5	67	342, 068	22, 351. 60	782, 306	80. 60	2, 821	22, 432. 20	785, 127	818, 247	588, 115	18	13	818, 265	588, 128
Santa Cruz	58	3	61	130, 642	8, 430. 40	295, 064	3. 80	133	8, 434. 20	295, 197	676, 185	486, 008			676, 185	486, 008
Yavapai	276	609	885	1, 078, 906	65, 509. 20	2, 292, 822	3, 732. 40	130, 634	69, 241. 60	2, 423, 456	1, 603, 488	1, 152, 507	526	378	1, 604, 014	1, 152, 885
Yuma	74	338	412	17, 169	2, 726. 00	95, 410	837. 40	29, 309	3, 563. 40	124, 719	8, 480	6, 095	128	92	8, 608	6, 187
	904	1, 197	2, 101	6, 770, 050	236, 597. 60	8, 280, 916	5, 157. 00	180, 495	241, 754. 60	8. 461, 411	6, 600, 448	4, 744, 072	832	598	6, 601, 280	4, 744, 670
Total, 1934	747	867	1, 614	3, 270, 242	160, 041. 86	5, 593, 463	6, 982 26	244, 030	167, 024. 12	5, 837, 493	4, 447, 436	2, 875, 110	1, 038	671	4, 448, 474	2, 875, 781

County	Copper		Lead		Zinc		Total value		
	Pounds	Value	Pounds	Value	Pounds	Value	Lode	Placer	Lode and placer
Cochise	64, 752, 277	$5, 374, 439	2, 654, 550	$106, 182			$9, 765, 176	$2, 249	$9, 767, 425
Gila	37, 415, 735	3, 105, 506	1, 955, 550	78, 222			3, 278, 181	1, 055	3, 279, 236
Graham							273	14	287
Greenlee	2, 181	181	2, 025	81			29, 077	2, 445	31, 522
Maricopa	139, 096	11, 545	800	32			206, 309	4, 704	211, 013
Mohave	57, 771	4, 795	175, 175	7, 007	133, 205	$5, 861	1, 769, 622	2, 993	1, 772, 615
Pima	67, 138, 554	5, 572, 500	28, 200	1, 128			6, 545, 502	4, 253	6, 549, 755
Pinal	31, 792, 434	2, 638, 772	589, 200	23, 568			4, 032, 761	2, 834	4, 035, 595
Santa Cruz	536, 096	44, 496	9, 503, 925	380, 157	6, 540, 727	287, 792	1, 493, 517	133	1, 493, 650
Yavapai	76, 172, 048	6, 322, 280	656, 625	26, 265			9, 793, 874	131, 012	9, 924, 886
Yuma	23, 097	1, 917	50	2			103, 424	29, 401	132, 825
	278, 029, 289	23, 076, 431	15, 566, 100	622, 644	6, 673, 932	293, 653	37, 017, 716	181, 093	37, 198, 809
Total, 1934	178, 082. 213	14, 246, 577	6, 877, 216	254, 457	1, 810, 279	77, 842	23, 047, 449	244, 701	23, 292, 15

Gold and silver produced at placer mines in Arizona in 1935, by counties, in fine ounces, in terms of recovered metals

County	Sluicing		Dry-land dredges[1]		Dragline floating dredges		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Cochise	63.60	32					63.60	32
Gila	30.00	7					30.00	7
Graham	.40						.40	
Greenlee	69.20	32					69.20	32
Maricopa	133.60	39					133.60	39
Mohave	85.00	25					85.00	25
Pima	121.00	25					121.00	25
Pinal	80.60	18					80.60	18
Santa Cruz	3.80						3.80	
Yavapai	1,136.87	188			2,595.53	338	3,732.40	526
Yuma	837.40	128					837.40	128
	2,561.47	494			2,595.53	338	5,157.00	832
Total, 1934	4,066.45	669	431.81	33	2,484.00	336	6,982.26	1,038

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

MINING INDUSTRY

Compared with 1932–34 the mining industry of Arizona in 1935 showed marked improvement. The important features of 1935 were the reopening, in January, of the United Verde mine at Jerome; the reopening, in September, of the Inspiration Consolidated property at Inspiration; the marked increase in the production of copper ore from the New Cornelia and Miami mines; the large gain in the output of siliceous gold ore from mines at Oatman, Katherine, Mammoth, Hillside, Cordes, and Octave; and the increase in the output of lead-zinc ore from Ruby, Santa Cruz County.

ORE CLASSIFICATION

Ore sold or treated in Arizona in 1935, with content in terms of recovered metals

Source	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold ore	651	492,213	98,864.94	283,091	467,939	1,101,143	
Dry gold and silver ore	37	86,192	12,543.27	426,818	275,983	117,155	
Dry silver ore	92	26,239	858.54	405,685	144,164	170,487	
	780	604,644	112,266.75	1,115,594	888,086	1,388,785	
Copper ore	82	6,011,755	112,783.79	4,545,944	276,469,902	3,915	
Lead ore	67	16,749	3,295.23	230,971	140,645	4,674,046	
Zinc ore	1	7,126	162.71	38,629	15,481	37,394	114,063
Copper-lead ore	3	4	.48	73	686	922	
Lead-zinc ore	2	129,772	8,088.64	669,237	514,489	9,461,038	6,559,869
	[1] 124	6,165,406	124,330.85	5,484,854	277,141,203	14,177,315	6,673,932
Total, lode mines	[1] 904	6,770,050	236,597.60	6,600,448	278,029,289	15,566,100	6,673,932
Total, placers	1,197		5,157.00	832			
	2,101	6,770,050	241,754.60	6,601,280	278,029,289	15,566,100	6,673,932
Total, 1934	1,614	3,270,242	167,024.12	4,448,474	178,082,213	6,877,216	1,810,279

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

Dry and siliceous ore.—The output of dry and siliceous ore was 604,644 tons from 780 properties in 1935, compared with 373,073 tons from 622 properties in 1934.

Copper ore.—Copper ore mined and treated totaled 6,011,755 tons from 82 properties in 1935, compared with 2,845,604 tons from 58 properties in 1934.

Lead ore.—The output of lead ore was 16,749 tons from 67 properties in 1935, compared with 16,203 tons of ore from 87 properties in 1934.

Copper-lead ore.—There were three small producers of copper-lead ore in 1935 and six in 1934. The output (4 tons) in 1935 was ore of smelting grade and came from sample lots from Pima and Santa Cruz Counties.

Lead-zinc ore.—Two mines (one in Santa Cruz County and one in Mohave County) produced 129,772 tons of lead-zinc ore in 1935 compared with two properties producing 35,315 tons in 1934.

Ore sold or treated in Arizona in 1935, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Cochise	25,244	6,037.78	39,534	146,265	43,984	
Gila	801	423.04	895	6,517	413	
Graham	2	1.71	11			
Greenlee	225	129.72	2,938	999	1,838	
Maricopa	56,944	4,781.52	4,498	17,105		
Mohave	169,362	45,541.82	78,943	4,824	9,915	
Pima	922	503.45	3,184	2,715	480	
Pinal	69,600	13,048.34	30,236	131,462	584,036	
Santa Cruz	877	466.23	2,329	2,723	1,496	
Yavapai	151,266	25,295.30	118,051	141,401	458,931	
Yuma	16,970	2,636.03	2,472	13,928	50	
	492,213	98,864.94	283,091	467,939	1,101,143	
Total, 1934	344,910	74,298.78	248,457	269,052	497,098	

DRY GOLD AND SILVER ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
Cochise	12,874	2,141.22	98,014	42,367	114,175	
Graham	2	2.29	174			
Greenlee	463	361.47	11,949	718		
Maricopa	36	.54	32	181	800	
Mohave	5,503	589.45	22,683	3,486	1,925	
Pima	903	36.49	1,877	2,075		
Pinal	4,833	1,044.03	53,296	70,813		
Santa Cruz	97	60.07	2,804	86		
Yavapai	61,481	8,307.71	235,989	156,257	255	
	86,192	12,543.27	426,818	275,983	117,155	
Total, 1934	15,919	2,120.30	110,858	134,269	4,611	

DRY SILVER ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
Cochise	7,871	384.29	57,354	12,233	26,249	
Gila	194	3.81	4,538	4,644	551	
Greenlee	150	5.11	991	87	187	
Mohave	558	48.28	13,346	2,407	5,738	
Pima	67	2.96	1,528	1,248	255	
Pinal	8,092	88.78	121,634	32,673	1,452	
Santa Cruz	15	.93	897	397	269	
Yavapai	9,183	319.91	199,434	89,391	135,786	
Yuma	109	4.47	5,963	1,084		
	26,239	858.54	405,685	144,164	170,487	
Total, 1934	12,244	1,530.43	270,028	49,049	230,002	

Ore sold or treated in Arizona in 1935, by counties, with content in terms of recovered metals—Continued

COPPER ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Cochise	572,746	50,780.87	2,559,744	64,473,327		
Gila	1,169,913	306.85	53,863	37,348,791		
Greenlee	6	.90	1	377		
Maricopa	1,578	35.34	31,815	121,810		
Mohave	159	43.69	1,343	29,003		
Pima	3,150,985	21,948.10	243,976	67,130,954	50	
Pinal	259,521	8,169.16	613,038	31,557,486		
Santa Cruz	80	5.27	656	18,276	1,365	
Yavapai	856,677	31,408.11	1,041,463	75,781,793	2,500	
Yuma	90	85.50	45	8,085		
	6,011,755	112,783.79	4,545,944	276,469,902	3,915	
Total, 1934	2,845,604	76,092.34	3,459,138	177,402,898	7,659	

LEAD ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
Cochise	10,954	2,571.04	191,473	78,085	2,470,142	
Gila	4,861	335.90	20,032	55,783	1,954,586	
Mohave	312	171.41	2,687	1,011	93,185	
Pima	104	30.60	4,866	1,090	27,121	
Pinal	22	1.29	43		3,712	
Santa Cruz	197	6.82	3,319	1,470	66,147	
Yavapai	299	178.17	8,551	3,206	59,153	
	16,749	3,295.23	230,971	140,645	4,674,046	
Total, 1934	16,203	3,333.44	168,938	77,625	2,763,993	

ZINC ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
Mohave	7,126	162.71	38,629	15,481	37,394	114,063
	7,126	162.71	38,629	15,481	37,394	114,063
Total, 1934						

COPPER-LEAD ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
Pima	2	0.40	18	472	294	
Santa Cruz	2	.08	55	214	628	
	4	.48	73	686	922	
Total, 1934	47	7.53	1,016	4,683	15,164	

LEAD-ZINC ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
Mohave	398	197.64	3,112	1,559	27,018	19,142
Santa Cruz	129,374	7,891.00	666,125	512,930	9,434,020	6,540,727
	129,772	8,088.64	669,237	514,489	9,461,038	6,559,869
Total, 1934	35,315	2,659.04	189,001	144,637	3,358,689	1,810,279

Zinc products (as marketed from Arizona mines and mills) sold to smelters in 1935

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of concentrates	Recovered zinc
		Short tons	*Pounds*	*Percent*	*Pounds*
Zinc concentrates	Mohave and Santa Cruz	7,128	7,415,452	52.02	6,673,932
		7,128	7,415,452	52.02	6,673,932
Total, 1934		2,031	2,000,486	49.25	1,810,279

METALLURGIC INDUSTRY

Of the total ore and old tailings produced in 1935 in Arizona, 4,815,612 tons were treated at concentration plants, 1,350,679 tons represented crude ore smelted, and 271,910 tons were treated at gold and silver mills; no ore was treated by straight leaching.

The following table summarizes data for operations at gold and silver mills in 1935, by counties.

Mine production of metals from gold and silver mills in Arizona in 1935, by counties, in terms of recovered metals

County	Ore and old tailings treated (dry weight)		Recovered in bullion			
			Amalgamation		Cyanidation	
	Ore	Old tailings	Gold	Silver	Gold	Silver
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*
Cochise	6,911		18.53	8	292.80	18,313
Gila	114		25.82	11		
Graham	2		1.71	11		
Greenlee	10		1.90	1		
Maricopa	18,486	25,590	1,384.46	299	1,011.19	1,919
Mohave	156,348	749	401.26	236	40,849.34	74,618
Pima	398	800	87.71	39	15.70	1,113
Pinal	29,959		64.46	26	2,434.81	4,224
Santa Cruz	75		29.62	23		
Yavapai	5,871	11,121	889.95	387	486.90	1,514
Yuma	4,886	10,590	772.32	182	1,047.24	893
	223,060	48,850	3,677.74	1,223	46,137.98	102,594
Total, 1934	186,670	41,030	4,038.80	1,442	32,789.50	64,413

County	Concentrates and recovered metal				
	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Cochise	1	5.04	8	27	100
Gila	1	4.20	2		
Maricopa	90	166.00	200	190	
Mohave	13	41.21	271	10	651
Pima	2	2.00	15		180
Yavapai	58	116.88	159	135	296
Yuma	49	208.81	86	289	
	214	544.14	741	651	1,227
Total, 1934	921	1,276.13	6,040	2,358	136,781

Mine production of metals from concentrating mills in Arizona in 1935, by counties, in terms of recovered metals

County	Ore and old tailings treated		Concentrates and recovered metal					
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Cochise	7,127		246	1,046.81	7,050	4,435	60,141	
Gila	837,398		25,706	285.57	52,935	29,739,052	51	
Greenlee	150		5	5.11	991	87	187	
Maricopa		10,000	175	430.01	450	1,855		
Mohave	24,386		1,087	3,780.52	64,962	19,740	68,166	133,205
Pima	3,150,957		120,836	21,947.42	243,078	67,120,028	723	
Pinal	241,121		87,762	8,879.81	425,649	22,644,283	585,995	
Santa Cruz	129,534		17,759	7,936.63	666,149	512,930	9,434,020	6,540,727
Yavapai	411,308	2,800	66,504	31,507.04	527,607	12,358,511	533,095	
Yuma	831		40	122.19	100	2,734	50	
	4,802,812	12,800	320,120	75,941.11	1,988,971	132,403,655	10,682,428	6,673,932
Total, 1934	2,263,836	3,500	189,255	35,757.05	1,029,717	74,077,811	3,655,111	1,810,279

Gross metal content of Arizona concentrates produced in 1935, by classes of concentrates

Class of concentrates	Concentrates produced (dry weight)	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	8,792	26,151.02	244,541	123,760	131,690	
Copper	289,741	33,532.10	917,983	135,611,008		
Lead	14,673	15,893.32	716,929	607,432	10,796,193	
Zinc	7,128	908.81	110,259	85,736	554,172	7,415,452
	320,334	76,485.25	1,989,712	136,427,936	11,482,055	7,415,452
Total, 1934	190,176	37,033.18	1,035,757	75,809,099	4,071,835	2,000,486

Mine production of metals from Arizona concentrates in 1935, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Cochise	247	1,051.85	7,058	4,462	60,241	
Gila	25,707	289.77	52,937	29,739,052	51	
Greenlee	5	5.11	991	87	187	
Maricopa	265	596.01	650	2,045		
Mohave	1,100	3,821.73	65,233	19,750	68,817	133,205
Pima	120,838	21,949.42	243,093	67,120,028	903	
Pinal	87,762	8,879.81	425,649	22,644,283	585,995	
Santa Cruz	17,759	7,936.63	666,149	512,930	9,434,020	6,540,727
Yavapai	66,562	31,623.92	527,766	12,358,646	533,391	
Yuma	89	331.00	186	3,023	50	
	320,334	76,485.25	1,989,712	132,404,306	10,683,655	6,673,932
Total, 1934	190,176	37,033.18	1,035,757	74,080,169	3,791,892	1,810,279

BY CLASSES OF CONCENTRATES

Dry and siliceous	8,792	26,151.02	244,541	116,922	84,778	
Copper	289,741	33,532.10	917,983	131,734,036		
Lead	14,673	15,893.32	716,929	485,644	10,100,325	
Zinc	7,128	908.81	110,259	67,704	498,552	6,673,932

The quantity of ore shipped crude from mines in Arizona to smelters increased from 774,937 tons in 1934 to 1,350,679 tons in 1935. More than 92 percent of it in 1935 was copper ore and the remainder was largely siliceous ore.

Gross metal content of Arizona crude ore shipped to smelters in 1935, by classes of ore

Class of ore	Quantity (dry weight)	Gross metal content			
		Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry and siliceous	79,494	26,359.43	577,540	605,331	333,556
Copper	1,254,547	80,337.63	3,694,429	144,744,259	7,070
Lead	16,634	3,256.94	229,544	175,580	4,954,187
Copper-lead	4	.48	73	776	983
	1,350,679	109,954.48	4,501,586	145,525,946	5,295,796
Total, 1934	774,937	85,800.97	3,338,703	107,852,668	3,557,583

Mine production of metals from Arizona crude ore shipped to smelters in 1935, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Cochise	615,530	60,478.67	2,919,242	64,223,402	2,557,930
Gila	7,033	753.01	26,312	148,077	1,955,499
Graham	2	2.29	174		
Greenlee	684	490.19	14,887	2,094	1,838
Maricopa	4,470	1,815.78	33,470	137,051	800
Mohave	1,826	1,564.46	19,665	12,989	106,358
Pima	825	468.21	11,142	18,526	27,297
Pinal	70,864	10,966.61	386,933	9,116,232	3,205
Santa Cruz	1,009	464.15	10,013	11,604	69,905
Yavapai	647,575	32,379.63	1,072,531	62,469,692	114,665
Yuma	861	571.48	7,217	20,074	
	1,350,679	109,954.48	4,501,586	136,159,741	4,837,497
Total, 1934	774,937	85,800.97	3,338,703	103,652,780	3,070,198

BY CLASSES OF ORE

Dry and siliceous	79,494	26,359.43	577,540	567,112	203,187
Copper	1,254,547	80,337.63	3,694,429	135,451,791	3,915
Lead	16,634	3,256.94	229,544	140,152	4,629,473
Copper-lead	4	.48	73	686	922

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1935, by counties and districts, in terms of recovered metals

County and district	Mines producing: Lode	Mines producing: Placer	Ore	Gold: Lode	Gold: Placer	Gold: Total	Silver: Lode	Silver: Placer	Silver: Total	Copper	Lead	Zinc	Total value
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Cochise County:													
California	4		8	0.06		0.06	405		405	253	25		$315
Circle Hills	1		1				43		43		600		55
Cochise	2		3	1.20		1.20	14		14	24			54
Dos Cabezas	13	5	4,529	1,835.74	2.40	1,838.14	6,215		6,215	80,892	42,150		77,202
Huachuca Mountain	5	4	17	15.94	10.00	25.94	64	7	71	229	100		982
Rucker Basin	2		20	1.06		1.06	480		480				382
Swisshelm	4		174	45.77		45.77	6,066		6,066	289	49,925		7,983
Teviston	5	17	41	211.83	37.40	249.23	231	7	238	120	575		8,927
Tombstone	13		22,454	3,574.06		3,574.06	269,330		269,330	106,590	2,161,250		413,970
Turquoise	4	3	1,782	78.40	.80	79.20	8,526		8,526	1,217			9,001
Warren	8	5	600,659	56,148.54	13.00	56,161.54	2,654,713	18	2,654,731	64,562,530	399,925		9,248,429
Winchester	1		1	2.60		2.60	32		32	133			125
Gila County:													
Banner	7	5	4,435	280.43	10.37	290.80	15,801		15,801	53,747	1,713,700		94,544
Globe-Miami	22	8	1,171,101	709.34	14.23	723.57	61,273	7	61,280	37,359,120	223,075		3,179,100
Green Valley	10	4	127	42.46	5.40	47.86	775		775	1,458			2,353
Pioneer [1]	4		104	34.17		34.17	1,479		1,479	1,410	18,775		3,127
Young	1		2	3.20		3.20							112
Graham County:													
Gila River		1			.40	.40							14
Rattlesnake	2		4	4.00		4.00	185		185				273
Greenlee County:													
Copper Mountain	5	12	844	497.20	18.63	515.83	15,879	18	15,897	2,181	2,025		29,742
San Francisco River and Chase Creek		24			50.57	50.57		14	14				1,780
Maricopa County:													
Agua Fria		3			.80	.80							28
Big Horn	3	6	115	36.40	20.80	57.20	25	11	36				2,028
Camp Creek	3		195	37.77		37.77	64		64	4,916			1,776
Cave Creek	18		161	91.83		91.83	110		110	1,229			3,395
Chandler	1		1	1.20		1.20							42
Dads Creek		1			3.40	3.40							119
Ellsworth [2]	3		59	31.46		31.46	18		18	84			1,121
Gila Bend Mountains	1		36	.54		.54	32		32	181	800		89
Hassayampa Creek		6			7.00	7.00		7	7				250
Magazine	1		1,577	35.06		35.06	31,815		31,815	121,578			34,185
Osborn	2		4	7.80		7.80	7		7				278
Pikes Peak	3		902	126.94		126.94	121		121				4,530

Salt River Mountains	7		2,196	1,423.37		1,423.37	1,298		1,298	8,205			51,432
San Domingo	4	47	64	13.17	76.00	89.17	14	14	28				3,141
Sunflower	1		29	54.86		54.86	25		25	96			1,946
Vulture	6	10	53,000	2,802.34	25.60	2,827.94	2,720	7	2,727	2,277			101,127
White Tank Mountains	3		45	12.17		12.17	32		32	60			454
Wickenburg	2		7	5.86		5.86							205
Winifred	1		167	136.63		136.63	64		64	470			4,867
Mohave County:													
Cedar Valley	4		107	7.74		7.74	1,166		1,166	25,072	600		3,214
Chemehuevis	6	4	161	110.46	20.60	131.06	50	11	61	2,133			4,808
Colorado River		1			16.60	16.60		7	7				586
Cottonwood	2		199	123.80		123.80	128		128	1,096	150		4,522
Gold Basin	3	11	316	125.66	24.20	149.86	50	7	57				5,286
Greenwood	4		60	55.57		55.57	32		32				1,968
Lost Basin	1	2	2	1.60	16.20	17.80	7		7				628
Maynard	4		1,342	489.37		489.37	2,976		2,976	337	3,575		19,438
Minnesota	1		328	458.97		458.97	320		320	952			16,373
Music Mountain	1		60	16.20		16.20	32		32		100		594
Owens	25		390	184.23		184.23	992		992	1,446	27,375		8,376
Peacock	1		46	11.00		11.00	654		654	72	650		887
Pilgrim	2		10,651	2,776.46		2,776.46	1,145		1,145				97,999
San Francisco (including Katherine and Portland)	44	1	154,091	40,239.54	7.00	40,246.54	74,119		74,119				1,461,902
Wallapai	34	1	14,775	1,664.80	.40	1,665.20	76,519		76,519	26,506	140,725	133,205	126,970
Weaver	7		890	489.60		489.60	2,553		2,553	157	2,000		19,064
Pima County:													
Ajo	4	1	(3)	(3)	(3)	(3)	(3)		(3)	(3)			(3)
Alder Creek		1			.60	.60							21
American	1		(3)	(3)		(3)	(3)		(3)	(3)	(3)		(3)
Amole	3		(3)	(3)		(3)	(3)		(3)	(3)	(3)		(3)
Arivaca	48	13	1,085	222.17	15.40	237.57	2,482	7	2,489	3,325	325		10,393
Baboquivari	18	1	264	142.06	5.60	147.66	3,406		3,406	10,976	250		8,537
Cababi	8	1	345	92.37	4.20	96.57	128		128	120	50		3,484
Catalina	1		(3)							(3)			(3)
Cerro Colorado	1		47	11.74		11.74	441		441	410			762
Empire	1	2	2	.06	2.00	2.06	64		64	12	875		154
Greaterville	7	42	34	27.94	89.60	117.54	256	18	274	337	2,450		4,437
Growler	1		(3)	(3)		(3)	(3)		(3)				(3)
Helvetia	1		(3)							(3)			(3)
Meyer	3		21	13.43		13.43	18		18				483
Papago	1		1	.14		.14	7		7	84			17
Pima	9		72	24.06		24.06	679		679	301	4,700		1,543
Quijotoa	7		103	22.66		22.66	64		64	494	375		895
San Luis	3		6	3.77		3.77	46		46	36	300		180
Santa Rosa	5		12	12.34		12.34	146		146	458	100		579
Silver Bell	1		24	1.23		1.23	89		89	12	13,175		635
Pinal County:													
Big Butte	1		230	26.80		26.80	14		14				948
Blackwater	1		16	2.94		2.94	32		32	193			142
Bunker Hill	1		57	4.86		4.86	224		224	31,349			2,933
Casa Grande	5		223	188.80		188.80	441		441	1,940			7,086
Cottonwood	3		97	47.77		47.77	39		39	289			1,724

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1935, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Pinal County—Continued.													
Gila River	1		19	7.14		7.14	7		7	96			$263
Goldfields	4		152	28.43		28.43	18		18	145			1,020
Hackberry	1		21	32.86		32.86	121		121	928			1,314
Mineral Creek	3		20	4.83		4.83	217		217	1,506			450
Mineral Hill	3		236	44.83		44.83	1,550		1,550	2,072			2,855
Old Hat	13	5	51,365	4,835.14	80.60	4,915.74	8,217	18	8,235	181	584,975		201,384
Owl Head	3		71	1.66		1.66	1,664		1,664	518			1,297
Pioneer [1]	15		289,148	17,015.26		17,015.26	802,944		802,944	31,747,458			3,807,689
Ripsey	1		263	98.54		98.54	1,863		1,863	4,940			5,198
Riverside	2		11	7.20		7.20							252
Saddle Mountain	5		139	4.54		4.54	896		896	819	4,225		1,040
Santa Cruz County:													
Harshaw	4		115	5.26		5.26	2,169		2,169	6,241	14,550		2,843
Nogales	2		5	2.74		2.74	14		14	12			107
Oro Blanco	28	3	130,260	8,382.66	3.80	8,386.46	670,944		670,944	514,855	9,434,525	6,540,727	1,483,673
Pajarito	3		9	.54		.54	384		384		3,225		424
Palmetto	2		25	.06		.06	18		18	11,783			993
Patagonia	7		152	36.83		36.83	1,223		1,223	1,711	25,800		3,342
Tyndall	7		22	1.17		1.17	448		448	1,145	2,650		564
Wrightson	5		54	1.14		1.14	985		985	349	23,175		1,704
Yavapai County:													
Big Bug	14	67	51,771	5,423.74	357.40	5,781.14	15,975	32	16,007	70,157	54,750		221,858
Black Canyon	9	27	50,972	7,663.94	52.60	7,716.54	97,863	7	97,870	26,157	413,600		359,138
Black Rock	16	1	2,906	242.17	4.40	246.57	19,495		19,495	71,687			28,592
Blue Tank	4	6	48	21.66	7.40	29.06	7		7	120			1,032
Bullard	2		1,802	733.86		733.86	416		416	39,024			29,223
Castle Creek	16	12	180	86.74	9.40	96.14	39	7	46	6,699			3,954
Cherry Creek	19		1,067	622.26		622.26	704		704	5,410			22,734
Copper Basin	1	120	6	11.86	257.80	269.66	7	39	46				9,471
Eureka	17	6	55,111	7,755.94	5.20	7,761.14	183,961		183,961	222,494			422,529
Granite	1		5	9.37		9.37							328
Granite Creek		7			2.40	2.40							84
Harper	1		24	15.03		15.03	25		25	72			550
Hassayampa	50	70	16,505	2,366.26	77.00	2,443.26	71,808	11	71,819	136,843	4,175		148,659
Humbug	19	30	1,295	431.43	45.80	477.23	985	11	996	1,892	1,250		17,626
Kirkland	7	7	101	208.54	9.60	218.14	96		96				7,704
Lynx Creek		142			2,611.60	2,611.60		359	359				91,664
Martinez	15	1	2,024	766.54	40.60	807.14	2,674	7	2,681	19,831			31,823
Mineral Point	1		66	91.26		91.26	50		50	96			3,238
Oak Creek		13			13.40	13.40		7	7				474

Peck	2		1,470	16.00		16.00	110,880		110,880	1,783	57,475		82,702
Pine Grove	4		1,112	185.66		185.66	3,033		3,033	7,506	1,750		9,371
Santa Maria River		4			16.20	16.20		7	7				572
Silver Mountain	1	1	50	22.17	3.20	25.37	64		64				934
Squaw Peak	2		172	15.37		15.37	2,905		2,905	1,699	5,175		2,974
Thumb Butte	5	4	36	26.43	.80	27.23	46		46	265			1,008
Tiger		6			6.80	6.80							238
Tip Top	9		148	72.97		72.97	2,567		2,567	542	150		4,450
Turkey Creek	4	2	30	2.86	6.00	8.86	736		736	253	1,875		935
Verde	4		851,993	30,849.54		30,849.54	1,049,934		1,049,934	75,535,518			8,103,822
Wagoner		8			6.80	6.80							238
Walker	13		3,489	299.40		299.40	31,808		31,808	8,349	73,250		36,964
Walnut Grove	3	23	101	23.94	52.20	76.14	18	18	36				2,691
Weaver	31	52	35,903	7,257.86	145.80	7,403.66	7,225	21	7,246	8,952	43,175		266,806
White Picacho	6		519	286.40		286.40	167		167	6,699			10,700
Yuma County:													
Castle Dome	8	2	44	34.94	2.40	37.34	206		206				1,455
Cienega	2		147	107.54		107.54	18		18	6,157			4,288
Colorado River		3			3.00	3.00							105
Dome		66			63.60	63.60		18	18				2,239
Ellsworth [2]	33		11,391	1,429.23		1,429.23	1,849		1,849	14,398	50		52,549
Eureka	3	1	150	19.26	5.80	25.06	7		7				882
Fortuna	5	1	652	58.23	4.00	62.23	25		25				2,196
Kofa	3	8	295	84.14	7.80	91.94	146		146	277			3,346
Laguna		41			63.40	63.40		14	14				2,229
La Paz	5	76	3,840	692.94	120.20	813.14	181	18	199				28,603
Muggins Mountains	2	24	275	139.66	49.20	188.86	39	14	53				6,648
Palomas Mountains	1		8	3.86		3.86							135
Planet	4		55	73.60		73.60	18		18	651			2,643
Plomosa	7	113	306	80.00	514.60	594.60	5,991	64	6,055	1,373			25,277
Sonora		3			3.40	3.40							119
Wellton	1		6	2.60		2.60				241			111
Undistributed [4]			3,150,967	21,948.03	3.60	21,951.63	247,623		247,623	67,121,989	5,600		6,517,635
Total Arizona	904	1,197	6,770,050	236,597.60	5,157.00	241,754.60	6,600,448	832	6,601,280	278,029,289	15,566,100	6,673,932	37,198,809

[1] Pioneer district lies in both Gila and Pinal Counties
[2] Ellsworth district lies in both Maricopa and Yuma Counties.
[3] Included under "Undistributed."
[4] Includes items entered as "(3)" above.

The high price of gold continued to cause a large gain in the number of both lode and placer producers in Arizona in 1935 and in the quantity of siliceous gold ore treated. The number of producing lode mines increased from 747 in 1934 to 904 in 1935 and the placer producers from 867 to 1,197. The output of gold ore was 492,213 tons from 651 properties in 1935 compared with 344,910 tons from 528 properties in 1934. The tonnage of copper ore mined and treated was 6,011,755 tons (nearly 89 percent of the State output) from 82 properties in 1935 compared with 2,845,604 tons from 58 properties in 1934. There were 150 producing districts in Arizona in 1935, and the Warren (Bisbee) district again led in value of output. It had the following production: Ore, 600,659 tons; gold, 56,161.54 ounces; silver, 2,654,731 ounces; copper, 64,562,530 pounds; and lead, 399,925 pounds. The value of the four metals was $9,248,429.

The output of the Tombstone district increased slightly; the chief output was from the Tombstone (Bunker Hill) property.

In the Globe-Miami district the output of ore increased to 1,171,101 tons, chiefly from the Miami mine.

In the Oatman, Katherine, and Portland regions of the San Francisco district, Mohave County, the increase in siliceous gold ore produced was notable.

At Ajo the New Cornelia Branch of the Phelps Dodge Corporation operated throughout the year; it was the largest producer of copper in the State.

At Superior in the Pioneer district the mine and smelter of the Magma Copper Co. were active, and a large production of gold, silver, and copper resulted. The Lake Superior & Arizona lease was a large producer of gold. In the Old Hat district in Pinal County considerable gold, chiefly from concentrates, was recovered at the New Year-Mohawk and Mammoth-St. Anthony mines.

The Eagle-Picher Mining & Smelting Co. operated its mine and mill at Ruby throughout the year; it was a large producer of silver, lead, and zinc.

In the Verde district the United Verde Copper Co., formerly the largest producer of copper, silver, and gold in Arizona, was again operated in January. The United Verde Extension continued operations but at a greatly reduced rate.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN CALIFORNIA

(MINE REPORT)

By Charles White Merrill and H. M. Gaylord [1]

SUMMARY OUTLINE

The output of gold, silver, copper, lead, and zinc from California ores, gravels, and re-treated tailings in 1936, in terms of recovered metals, was 1,077,442 fine ounces of gold valued at $37,710,470; 2,103,799 fine ounces of silver valued at $1,629,392; 8,762,000 pounds of copper valued at $806,104; 964,000 pounds of lead valued at $44,344; and 16,000 pounds of zinc valued at $800—a total of $40,191,110 for the five metals. In 1935 California mines yielded 890,430 ounces of gold valued at $31,165,050; 1,191,112 ounces of silver valued at $856,112; 1,954,000 pounds of copper valued at $162,182; 1,134,000 pounds of lead valued at $45,360; and 322,000 pounds of zinc valued at $14,168—a total of $32,242,872. The quantity and value of all the metals except lead and zinc increased substantially. Gold increased 21 percent in both quantity and value, silver 77 percent in quantity and 90 percent in value, and copper 348 percent in quantity and 397 percent in value; lead decreased 15 percent in quantity and 2 percent in value and zinc 95 percent in both quantity and value. The value of the five metals increased 25 percent in 1936 over 1935. Moreover, the upward trend in quantity production carried the total value of the metals above that in any year since 1862. Gold comprised 94 percent and silver 4 percent of the total value of the five metals; the remaining 2 percent was accredited almost entirely to copper. The enormous production of gold in the Grass Valley-Nevada City district was the principal factor in maintaining Nevada County in first position among the nonferrous metal-producing counties of the State, but a very large output was also reported from

[1] The assistance of O. Y. Sharman is acknowledged.

a number of other counties. In Sacramento, Yuba, and Merced Counties gold dredges produced great quantities of gold. The two deepest lode mines in the State, the Argonaut and the Kennedy, are situated on the Mother Lode in Amador County. In addition to Amador County the other four Mother Lode counties—Eldorado, Calaveras, Tuolumne, and Mariposa—each continued in 1936 to have many operating lode-gold mines; and in Plumas County the Walker mine again produced large quantities of copper. In the southern part of the State the increasing output of the Mojave district restored Kern County to its former place as a leading gold producer.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the prices given in the table that follows. Gold in 1932 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1837, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95 per ounce, the yearly average weighted United States Government price [2]; and in 1935 and 1936 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1932 and 1933 is the average New York price for bar silver; in 1934, the Treasury buying price ($0.64646464+ per ounce) for newly mined silver; and in 1935 and 1936, the yearly average weighted Treasury buying price for newly mined silver. The copper, lead, and zinc prices are weighted yearly averages of all grades of primary metal sold by producers.

Prices of gold, silver, copper, lead, and zinc, 1932–36

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[1] $20.67+	$0.282	$0.063	$0.030	$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050

[1] $20.671835. [2] $0.64646464.

Mine production of gold, silver, copper, lead, and zinc in California, 1932–36, in terms of recovered metals

Year	Mines producing		Ore, old tailings, etc. (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1932	718	828	1,060,361	569,166.99	$11,765,726	493,533	$139,176
1933	797	993	1,322,100	613,578.85	15,683,075	402,591	140,907
1934	867	1,784	2,356,091	719,063.92	25,131,284	844,413	545,883
1935	1,112	1,487	3,337,773	890,430.00	31,165,050	1,191,112	856,112
1936	903	639	4,635,691	1,077,442.00	37,710,470	2,103,799	1,629,392

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1932	1,417,876	$89,326	2,417,416	$72,522			$12,066,750
1933	990,380	63,384	761,156	28,163	290,214	$12,189	15,927,718
1934	569,068	45,525	823,168	30,457	721,719	31,034	25,784,183
1935	1,954,000	162,182	1,134,000	45,360	322,000	14,168	32,242,872
1936	8,762,000	806,104	964,000	44,344	16,000	800	40,191,110

[2] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Gold.—The production of recoverable gold in California was 1,077,-442 fine ounces valued at $37,710,470 in 1936—an increase of 21 percent in quantity and value over 1935. Lode mines produced 668,019 ounces of gold valued at $23,380,665 or 62 percent of the total gold; placer mines produced 409,423 ounces of gold valued at $14,329,805 or 38 percent of the total. In 1935 lode mines produced 61 percent and placer mines 39 percent of the total, and in 1934 the percentages were 62 and 38 percent, respectively. There follows a list of companies (or mines) operating lode-gold mines, arranged roughly in their order of importance as producers: Empire Star Mines Co., Ltd. (Nevada County), Idaho Maryland Mines Corporation (Nevada County), Lava Cap Gold Mining Corporation (Nevada County), Golden Queen Mining Co. (Kern County), Kennedy Mining & Milling Co. (Amador County), Argonaut Mining Co., Ltd. (Amador County), the Iron Mountain property of the Mountain Copper Co., Ltd. (Shasta County), the Big Canyon property of the Mountain Copper Co., Ltd. (Eldorado County), the Carson Hill Gold Mining Co. (Calaveras County), Cardinal Gold Mining Co. (Inyo County), Original Sixteen to One Mine, Inc. (Sierra County), the Yellow Aster mine of the Anglo American Mining Corporation (Kern County). Walker Mining Co. (Plumas County), and Tropico mine operated by Burton Bros., Inc. (Kern County). The following were the leading gold producers from placers in California, arranged roughly in order of their output in 1936: Yuba Consolidated Gold Fields (Yuba County), Natomas Co. (Sacramento County), Capital Dredging Co. (Sacramento County), Snelling Gold Dredging Co. (Merced County), Yuba Consolidated Gold Fields (Merced County), Arroyo Seco Gold Dredging Co. (Amador County), Gold Exploration Mining Co. (Yuba County), and the Comanche Gold Dredging Co. (Calaveras County). The lode and placer mines listed produced over three-fifths of the State's total gold. In all, there were 903 lode and 639 placer mines operating during the year. Since the depression many people lacking other employment have panned gold by hand in the streams of California with the hope of extracting enough to furnish the bare necessities of life. Although the average income of this class of miners has been small, a few of the more fortunate ones have discovered rich pockets. A special study of the 1935 production of the small-scale placer-gold miners was made by the Bureau during the year in cooperation with the Works Progress Administration. The miners usually worked ground they did not own. The total output for 1935 exceeded $1,000,000 and over 19,000 men were thus engaged at some time during the year. Although definite figures are not available for 1936, it appears that this class of miners again contributed a large quantity of bullion to the State production. Greater employment opportunities in other fields appear to have somewhat decreased the number on the creeks; many, however, are still working on the streams.

Silver.—The production of recoverable silver in California was 2,103,799 fine ounces valued at $1,629,392 in 1936 compared with 1,191,112 fine ounces valued at $856,112 in 1935—an increase of 77 percent in quantity and 90 percent in value. The companies (or mines) producing the largest quantities of silver, in the approximate order of their importance, are as follows: Sierra Consolidated Mines, Inc. (Mono County), Walker Mining Co. (Plumas County), Golden Queen Mining Co. (Kern County), Lava Cap Gold Mining Corpora-

tion (Nevada County), Kelly mine (Kern County), and the Empire Star Mines Co., Ltd. (Nevada County). The Sierra Consolidated Mines, Inc., works its Silverado mine principally for silver, but the other leading silver producers derived the bulk of their revenue from other metals. The Walker mine was worked mainly for the copper content of its ores; the other mines listed were worked for gold. On the other hand, almost all the mines in the State derived at least a small amount of revenue from silver; even the gold dredges found the silver content of their bullion a profitable byproduct.

Copper.—The production of recoverable copper in California was 8,762,000 pounds valued at $806,104 in 1936 compared with 1,954,000 pounds valued at $162,182 in 1935—an increase of 348 percent in quantity and 397 percent in value. The Walker Mining Co. in Plumas County, reopened in August 1935, was by far the most important producer of copper ore in California during 1936 and made over nine-tenths of the State's output. Small quantities of copper were also derived from a number of gold ores, the metallurgical treatment of which included concentration and shipment of the concentrates for smelting.

Lead.—The production of recoverable lead in California was 964,000 pounds valued at $44,344 in 1936 compared with 1,134,000 pounds valued at $45,360 in 1935—a decrease of 15 percent in quantity and 2 percent in value. Inyo County continued to be the leading producer of lead-bearing ore, but considerable quantities of the metal were derived from gold concentrates, particularly in the Grass Valley-Nevada City district.

Zinc.—The production of recoverable zinc in California was 16,000 pounds valued at $800 in 1936 compared with 322,000 pounds valued at $14,168 in 1935—a decrease of 95 percent in both quantity and value. The only zinc producer in 1936 was the Blue Light mine in Orange County, and it was idle at the close of the year.

Gold and silver produced at placer mines in California, 1931–35, in terms of recovered metals

Year	Dredge [1]				Drift			
	Gold		Silver		Gold		Silver	
	Fine ounces	Value	Fine	Value	Fine ounces	Value	Fine ounces	Value
1931	175,086.28	$3,619,355	10,602	$3,075	5,379.26	$111,199	687	$199
1932	188,830.89	3,903,481	11,269	3,178	9,959.43	205,880	1,166	329
1933	201,710.32	5,155,716	12,730	4,455	16,981.08	434,036	1,862	652
1934	194,051.48	6,782,099	12,386	8,007	12,992.78	454,098	1,511	977
1935	266,066.51	9,312,328	18,222	13,097	17,139.52		1,953	1,404

Year	Hydraulic				Small-scale surface [2]				Total value
	Gold		Silver		Gold		Silver		
	Fine ounces	Value	Fine	Value	Fine ounces	Value	Fine ounces	Value	
1931	3,026.16	$62.556		$110	11,011.90	$227,636	1,545	$448	$4,024,578
1932	5,944.15	122,876		196	25,795.39	533,238	3,469	978	4,770,156
1933	4,494.94	114,890	472	165	38,192.52	976,201	5,396	1,889	6,688,004
1934	9,281.75	324,397	1,105	714	57,698.82	2,016,574	8,246	5,331	9,592,197
1935	13,623.10	476,809	1,416	1,018	48,696.87	1,704,390	2,311	1,661	12,110,590

1 In 1935 includes bucket, dragline, suction, and dry-land dredges; in earlier years includes only bucket dredge output.

2 In 1935 includes long toms, dip boxes, pans, ground sluices, and other small-hand methods; in earlier years dragline and dry-land dredge production included.

Gold and silver produced at placer mines in California in 1935, by classes of mines and by methods of recovery, in terms of recovered metals

Class and method	Number of operators [1]	Material treated (cubic yards)	Gold		Silver		Total value	Average value recovered metal per cubic yard
			Fine ounces	Value	Fine ounces	Value		
Surface placers:								
Gravel mechanically handled:								
Floating dredge with connected buckets	[2] 20	71,282,173	238,042.54	$8,331,489	16,022	$11,516	$8,343,005	$0.117
Dragline dredge [3]	[4] 32	3,405,566	21,216.19	742,567	1,668	1,199	743,766	.218
Dry-land dredge [5]	[4] 12	426,575	6,807.78	238,272	532	382	238,654	.559
Gravel hydraulically handled: Hydraulic	89	(6)	13,623.10	476,809	1,416	1,018	477,827	(6)
Small-scale hand methods: Sluice, long tom, dip box, pan, etc	1,192	(6)	48,696.87	1,704,390	2,311	1,661	1,706,051	(6)
Underground placers: Drift	142	(6)	17,139.52	599,883	1,953	1,404	601,287	(6)
	1,487	[7] 75,114,314	345,526.00	12,093,410	23,902	17,180	12,110,590	[8] .124

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] 36 dredges operated by 20 operators.
[3] Includes all placer operations using dragline type of power shovel for excavating and delivering gravel to floating washing plant.
[4] Each operator had 1 boat.
[5] Includes all placer operations using power excavator and washing plant, both on dry land.
[6] Not reported.
[7] Quantity treated by dredges only.
[8] Average value of recovered metal per yard of gravel treated by dredges only.

Gold produced at placer mines in California, 1935–36, by classes of mines and by methods of recovery, in terms of recovered metal

Class and method	1935		1936	
	Fine ounces	Value	Fine ounces	Value
Surface placers:				
Gravel mechanically handled:				
Floating dredge with connected buckets [1]	238,042.54	$8,331,489	285,693.49	$9,999,272
Dragline dredge [2] [3]	21,216.19	742,567	34,913.91	1,221,987
Dry-land dredge [3] [4]	6,807.78	238,272	17,107.92	598,777
Gravel hydraulically handled: Hydraulic	13,623.10	476,809	7,670.00	268,450
Small-scale hand methods: Sluice, long tom, dip box, pan, etc	48,696.87	1,704,390	40,105.76	1,403,702
Underground placers: Drift	17,139.52	599,883	23,931.92	837,617
	345,526.00	12,093,410	409,423.00	14,329,805

[1] 36 dredges operated by 20 operators in 1935 and 45 dredges operated by 28 operators in 1936.
[2] Includes all placer operations using dragline type of power shovel for excavating and delivering gravel to floating washing plant.
[3] Each operator had 1 boat.
[4] Includes all placer operations using power excavator and washing plant, both on dry land.

The production of gold in California represented more than 95 percent of the combined value of the gold, silver, copper, lead, and zinc output of the State for several years preceding 1936. During 1936, however, the revival of copper mining in Plumas County and the larger silver production in a number of areas, notably in Kern, Mono, and Napa Counties, caused the proportionate importance of gold to drop to 94 percent of the total value of the five metals. The production of gold, nevertheless, increased considerably during the year at both lode

and placer mines, and it appeared that the stimulating effect of the higher price for the metal had not yet run its course. Toward the close of the year, however, rising wages and higher material and supply costs began to make themselves felt. Along the Mother Lode a number of old mines were being reopened, and in the Mojave district of Kern County the exploration of the last 2 or 3 years began to yield substantial results.

At the placer mines of California, dredges of various types continued to produce the bulk of the gold recovery. Conventional dredges of the connected-bucket type increased their yield of gold by over 50,000 ounces compared with 1935 and yielded 71 percent of the placer-gold output of the State. Outstanding mining innovations of the last few years have been the developments of the dragline and dry-land dredges; the former produced over 1½ times as much gold in 1936 as in 1935, and the latter more than doubled its output. The dredges classified as draglines are those having floating washing plants to which the auriferous gravel is delivered by the dragline type of power shovel. Plants have been classified as dry-land dredges when the washing plant has been mounted on dry land and the gravel to be treated has been excavated by mechanical means. On the other hand, production at hydraulic mines declined during the year to a little over one-half that for 1935, partly because of drought conditions in some of the hydraulic areas but probably more largely because of the application of legal restrictions. Production by small-scale hand methods decreased about 20 percent. Undoubtedly improved employment opportunities caused many of those following this means of livelihood to turn to other types of employment. Water shortage handicapped the small operators in some areas. The drift mines made a substantial increase in production as recorded.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in California, 1935–36, by counties, in terms of recovered metals

1935

County	Gold					
	Lode		Placer		Total	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Alameda	----------	----------	----------	----------	----------	----------
Alpine	8.00	$280	----------	----------	8.00	$280
Amador	64,537.76	2,258,822	10,154.66	$355,413	74,692.42	2,614,235
Butte	3,088.23	108,088	24,129.84	844,544	27,218.07	952,632
Calaveras	26,575.54	930,144	19,345.66	677,098	45,921.20	1,607,242
Colusa	26.80	938	----------	----------	26.80	938
Del Norte	16.92	592	120.16	4,206	137.08	4,798
Eldorado	45,260.60	1,584,121	6,264.21	219,247	51,524.81	1,803,368
Fresno	139.18	4,871	450.68	15,774	589.86	20,645
Glenn	----------	----------	.06	2	.06	2
Humboldt	----------	----------	905.05	31,677	905.05	31,677
Imperial	1,234.31	43,201	463.01	16,205	1,697.32	59,406
Inyo	18,283.27	639,914	469.28	16,425	18,752.55	656,339
Kern	38,827.50	1,358,963	933.80	32,683	39,761.30	1,391,646
Kings	----------	----------	2.37	83	2.37	83
Lake	----------	----------	1.85	65	1.85	65
Lassen	345.26	12,084	2.81	98	348.07	12,182
Los Angeles	5,450.89	190,781	817.82	28,624	6,268.71	219,405
Madera	370.09	12,953	241.63	8,457	611.72	21,410
Mariposa	13,632.17	477,126	1,069.10	37,418	14,701.27	514,544
Merced	----------	----------	37,210.54	1,302,369	37,210.54	1,302,369
Modoc	2.40	84	----------	----------	2.40	84
Mono	1,081.89	37,866	60.79	2,128	1,142.68	39,994
Monterey	5.85	205	2.63	92	8.48	297
Napa	112.20	3,927	1.64	57	113.84	3,984
Nevada	240,865.60	8,430,296	10,137.24	354,803	251,002.84	8,785,099
Orange	32.98	1,154	----------	----------	32.98	1,154
Placer	11,502.29	402,580	14,935.12	522,729	26,437.41	925,309
Plumas	3,386.66	118,533	2,552.08	89,323	5,938.74	207,856
Riverside	3,079.74	107,791	121.89	4,266	3,201.63	112,057
Sacramento	28.77	1,007	113,799.36	3,982,978	113,828.13	3,983,985
San Bernardino	6,036.45	211,276	1,935.55	67,744	7,972.00	279,020
San Diego	271.87	9,515	24.33	852	296.20	10,367
San Joaquin	----------	----------	2,848.50	99,698	2,848.50	99,698
San Luis Obispo	----------	----------	8.19	287	8.19	287
Santa Cruz	14.27	499	3.36	118	17.63	617
Shasta	23,145.77	810,102	4,352.75	152,346	27,498.52	962,448
Sierra	18,423.34	644,817	5,611.45	196,401	24,034.79	841,218
Siskiyou	6,344.17	222,046	10,103.71	353,630	16,447.88	575,676
Sonoma	----------	----------	9.07	317	9.07	317
Stanislaus	----------	----------	8,375.10	293,129	8,375.10	293,129
Sutter	----------	----------	10.19	357	10.19	357
Tehama	----------	----------	5.07	177	5.07	177
Trinity	5,399.31	188,976	15,394.61	538,811	20,793.92	727,787
Tulare	6.74	236	20.47	716	27.21	952
Tuolumne	5,911.54	206,904	2,261.65	79,158	8,173.19	286,062
Ventura	193.79	6,783	----------	----------	193.79	6,783
Yolo	----------	----------	20.44	715	20.44	715
Yuba	1,261.85	44,165	50,348.28	1,762,190	51,610.13	1,806,355
	544,904.00	19,071,640	345,526.00	12,093,410	890,430.00	31,165,050

Mine production of gold, silver, copper, lead, and zinc in California, 1935–36, by counties, in terms of recovered metals—Continued

1935—Continued

County	Silver					
	Lode		Placer		Total	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Alameda						
Alpine	226	$162			226	$162
Amador	23,494	16,886	1,040	$748	24,534	17,634
Butte	4,470	3,213	1,453	1,044	5,923	4,257
Calaveras	9,690	6,965	1,744	1,253	11,434	8,218
Colusa	9	6			9	6
Del Norte	2	1	3	2	5	3
Eldorado	7,762	5,579	506	364	8,268	5,943
Fresno	130	93	36	26	166	119
Glenn						
Humboldt			98	70	98	70
Imperial	4,142	2,977	5	4	4,147	2,981
Inyo	38,417	27,612	12	9	38,429	27,621
Kern	147,312	105,881	135	97	147,447	105,978
Kings						
Lake						
Lassen	395	284	1	1	396	285
Los Angeles	5,428	3,901	325	234	5,753	4,135
Madera	82	59	34	24	116	83
Mariposa	6,756	4,856	79	57	6,835	4,913
Merced			3,841	2,761	3,841	2,761
Modoc	11	8			11	8
Mono	101,050	72,630	6	4	101,056	72,634
Monterey	1	1			1	1
Napa	11,785	8,470			11,785	8,470
Nevada	519,786	373,596	576	414	520,362	374,010
Orange	15,461	11,113			15,461	11,113
Placer	17,511	12,586	1,430	1,028	18,941	13,614
Plumas	47,718	34,297	146	105	47,864	34,402
Riverside	2,707	1,946	10	7	2,717	1,953
Sacramento	44	32	4,356	3,131	4,400	3,163
San Bernardino	159,417	114,581	216	155	159,633	114,736
San Diego	89	64	1	1	90	65
San Joaquin			151	109	151	109
San Luis Obispo						
Santa Cruz	8	6			8	6
Shasta	32,928	23,667	193	138	33,121	23,805
Sierra	4,320	3,105	212	152	4,532	3,257
Siskiyou	1,169	840	1,071	770	2,240	1,610
Sonoma						
Stanislaus			1,064	765	1,064	765
Sutter						
Tehama						
Trinity	1,920	1,380	1,567	1,126	3,487	2,506
Tulare	6	4	7	5	13	9
Tuolumne	2,643	1,900	110	79	2,753	1,979
Ventura	44	32			44	32
Yolo						
Yuba	277	199	3,474	2,497	3,751	2,696
	1,167,210	838,932	23,902	17,180	1,191,112	856,112

Mine production of gold, silver, copper, lead, and zinc in California, 1935–36, by counties, in terms of recovered metals—Continued

1935—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Alameda	26,291	$2,182					$2,182
Alpine	29	2	212	$8			452
Amador	6,582	546	1,235	49			2,632,464
Butte	221	18	32	1			956,908
Calaveras	436	36	163	7			1,615,503
Colusa							944
Del Norte							4,801
Eldorado	13,967	1,159	543	22			1,810,492
Fresno	23	2					20,766
Glenn							2
Humboldt							31,747
Imperial							62,387
Inyo	49,612	4,118	691,114	27,645	265,870	$11,698	727,421
Kern	1,836	152	4,382	175			1,497,951
Kings							83
Lake							65
Lassen	93	8	139	6			12,481
Los Angeles	2,285	190	230	9			223,739
Madera							21,493
Mariposa	2,335	194	1,440	58			519,709
Merced							1,305,130
Modoc	192	16					108
Mono	1,763	146	6,462	258			113,032
Monterey							298
Napa	445	37	17	1			12,492
Nevada	166,113	13,787	342,856	13,714			9,186,610
Orange	528	44	40,702	1,628	56,130	2,470	16,409
Placer	765	63	565	23			939,009
Plumas	1,654,019	137,284					379,542
Riverside	3,795	315	14,725	589			114,914
Sacramento	9	1	58	2			3,987,151
San Bernardino	12,929	1,073	26,826	1,073			395,902
San Diego	24	2					10,434
San Joaquin							99,807
San Luis Obispo							287
Santa Cruz							623
Shasta	6,247	519	1,580	63			986,835
Sierra	1,128	94					844,569
Siskiyou	600	50					577,336
Sonoma							317
Stanislaus							293,894
Sutter							357
Tehama							177
Trinity	581	48	397	16			730,357
Tulare							961
Tuolumne	1,104	92	180	7			288,140
Ventura							6,815
Yolo							715
Yuba	48	4	142	6			1,809,061
	1,954,000	162,182	1,134,000	45,360	322,000	14,168	32,242,872

Mine production of gold, silver, copper, lead, and zinc in California, 1935–36, counties, in terms of recovered metals—Continued

1936

County	Mines producing		Gold					
			Lode		Placer		Total	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Amador	46	19	80,621	$2,821,735	16,589	$580,615	97,210	$3,402,350
Butte	22	46	5,631	197,085	28,725	1,005,375	34,356	1,202,460
Calaveras	53	61	28,105	983,675	32,268	1,129,380	60,373	2,113,055
Eldorado	53	29	53,305	1,865,675	3,516	123,060	56,821	1,988,735
Fresno	3	6	125	4,375	310	10,850	435	15,225
Humboldt [1]	(1)	13	(1)	(1)	1,033	36,155	[1] 1,033	[1] 36,155
Imperial	8	3	899	31,465	300	10,500	1,199	41,965
Inyo	54	9	20,482	716,870	779	27,265	21,261	744,135
Kern	103	14	67,717	2,370,095	891	31,185	68,608	2,401,280
Lassen	4	-------	886	31,010	-------	-------	886	31,010
Los Angeles	18	7	4,198	146,930	860	30,100	5,058	177,030
Madera	14	9	344	12,040	327	11,445	671	23,485
Mariposa	67	20	21,174	741,090	3,497	122,395	24,671	863,485
Merced [1]	(1)	5	(1)	(1)	41,776	1,462,160	[1] 41,776	[1] 1,462,160
Mono [2]	20	(2)	1,832	64,120	(2)	(2)	[2] 1,832	[2] 64,120
Nevada	42	32	272,673	9,543,555	10,106	353,710	282,779	9,897,265
Placer	36	57	15,483	541,905	23,557	824,495	39,040	1,366,400
Plumas	19	37	20,315	711,025	2,027	70,945	22,342	781,970
Riverside	35	9	5,770	201,950	405	14,175	6,175	216,125
Sacramento	-------	9	-------	-------	104,575	3,660,125	104,575	3,660,125
San Bernardino	76	7	2,898	101,430	1,105	38,675	4,003	140,105
San Diego [2]	7	(2)	62	2,170	(2)	(2)	[2] 62	[2] 2,170
Shasta	32	26	21,331	746,585	15,943	558,005	37,274	1,304,590
Sierra	22	31	19,530	683,550	2,497	87,395	22,027	770,945
Siskiyou	52	82	9,933	347,655	8,325	291,375	18,258	639,030
Stanislaus [1]	(1)	5	(1)	(1)	8,285	289,975	[1] 8,285	[1] 289,975
Trinity	30	52	4,317	151,095	15,932	557,620	20,249	708,715
Tulare	6	-------	24	840	-------	-------	24	840
Tuolumne	59	26	8,912	311,920	4,691	164,185	13,603	476,105
Ventura	3	-------	67	2,345	-------	-------	67	2,345
Yuba	8	16	424	14,840	80,934	2,832,690	81,358	2,847,530
Combined counties [3]	11	9	961	33,635	170	5,950	1,131	39,585
	903	639	668,019	23,380,665	409,423	14,329,805	1,077,442	37,710,470

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California, 1935–36, by counties, in terms of recovered metals—Continued

1936—Continued

County	Silver					
	Lode		Placer		Total	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Amador	21,534	$16,678	1,831	$1,418	23,365	$18,096
Butte	10,649	8,248	1,999	1,548	12,648	9,796
Calaveras	12,877	9,973	2,929	2,269	15,806	12,242
Eldorado	11,275	8,732	427	331	11,702	9,063
Fresno	38	29	58	45	96	74
Humboldt [1]	(1)	(1)	152	118	[1] 152	[1] 118
Imperial	711	551	29	22	740	573
Inyo	51,504	39,890	7	5	51,511	39,895
Kern	381,540	295,503	114	88	381,654	295,591
Lassen	2,343	1,815			2,343	1,815
Los Angeles	2,324	1,800	120	93	2,444	1,893
Madera	185	143	48	37	233	180
Mariposa	5,619	4,352	522	404	6,141	4,756
Merced [1]	(1)	(1)	4,433	3,433	[1] 4,433	[1] 3,433
Mono [2]	425,106	329,245	(2)	(2)	[2] 425,106	[2] 329,245
Nevada	452,893	350,766	2,452	1,899	455,345	352,665
Placer	17,786	13,775	2,959	2,292	20,745	16,067
Plumas	283,938	219,910	223	173	284,161	220,083
Riverside	6,219	4,817	13	10	6,232	4,827
Sacramento			4,239	3,283	4,239	3,283
San Bernardino	235,326	182,260	107	83	235,433	182,343
San Diego [2]	16	12	(2)	(2)	[2] 16	[2] 12
Shasta	28,004	21,689	1,325	1,026	29,329	22,715
Sierra	4,230	3,276	243	188	4,473	3,464
Siskiyou	2,546	1,972	1,163	901	3,709	2,873
Stanislaus [1]	(1)	(1)	989	766	[1] 989	[1] 766
Trinity	1,120	867	1,787	1,384	2,907	2,251
Tulare	59	46			59	46
Tuolumne	3,328	2,578	581	450	3,909	3,028
Ventura	4	3			4	3
Yuba	146	113	4,322	3,347	4,468	3,460
Combined counties [3]	109,398	84,729	9	7	109,407	84,736
	2,070,718	1,603,772	33,081	25,620	2,103,799	1,629,392

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California, 1935–36, by counties, in terms of recovered metals—Continued

1935—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Amador	16,000	$1,472	2,000	$92			$3,422,010
Butte							1,212,256
Calaveras			4,000	184			2,125,481
Eldorado	12,000	1,104					1,998,902
Fresno							15,299
Humboldt [1]							[1] 36,273
Imperial							42,538
Inyo	72,000	6,624	556,000	25,576			816,230
Kern							2,696,871
Lassen							32,825
Los Angeles	2,000	184					179,107
Madera							23,665
Mariposa	4,000	368					868,609
Merced [1]							[1] 1,465,593
Mono [2]	8,000	736	32,000	1,472			[2] 395,573
Nevada	134,000	12,328	276,000	12,696			10,274,954
Placer			4,000	184			1,382,651
Plumas	8,478,000	779,976	2,000	92			1,782,121
Riverside			6,000	276			221,228
Sacramento							3,663,408
San Bernardino	22,000	2,024	62,000	2,852			327,324
San Diego [2]							[2] 2,182
Shasta							1,327,305
Sierra							774,409
Siskiyou	2,000	184					642,087
Stanislaus [1]							[1] 290,741
Trinity							710,966
Tulare							886
Tuolumne	8,000	736					479,869
Ventura							2,348
Yuba							2,850,990
Combined counties [3]	4,000	368	20,000	920	16,000	$800	126,409
	8,762,000	806,104	964,000	44,344	16,000	800	40,191,110

[1] Lode-mine production included under "Combined counties."
[2] Placer-mine production included under "Combined counties."
[3] Includes lode-mine production from Alpine, Humboldt, Merced, Napa, Orange, Santa Clara, Santa Cruz, and Stanislaus Counties; placer-mine production from Del Norte, Mono, Monterey, San Diego, San Joaquin, and San Luis Obispo Counties.

Ore treated and gold and silver recovered at gold mills in the Mother Lode counties in California in 1935 [1]

County	Ore treated	Gold and silver recovered in bullion			Concentrates produced[2]	Gold and silver recovered from concentrates			Value of total recovery	
		Gold	Silver	Average value per ton of ore		Gold	Silver	Average value per ton of concentrates	Total	Average value per ton of ore
	Short tons	*Fine ounces*	*Fine ounces*		*Short tons*	*Fine ounces*	*Fine ounces*			
Amador	184,295	33,890.91	8,608	$6.47	3,987	11,129.29	7,386	$99.03	$1,587,203	$8.61
Calaveras	312,715	19,065.85	4,687	2.14	1,846	6,998.90	3,813	134.18	918,377	2.94
Eldorado	261,434	10,935.09	3,624	1.47	11,584	28,042.31	3,228	84.93	1,369,134	5.24
Mariposa	27,570	6,442.04	1,691	8.22	48	174.06	1,405	147.96	233,788	8.48
Tuolumne	27,060	4,093.73	942	5.32	436	1,301.14	781	105.74	190,059	7.02
	813,074	74,427.62	19,552	3.22	17,901	47,645.70	16,613	93.82	4,298,561	5.29
Total, 1934	641,862	86,660.49	22,595	4.74	7,985	29,430.61	9,530	129.59	4,078,152	6.35

[1] Old tailings and mill cleanings excluded.
[2] Includes only concentrates recovered from gold ore.

MINING INDUSTRY

ORE CLASSIFICATION

Ore, old tailings, etc., sold or treated in California in 1935, with content in terms of recovered metals

Source	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold ore	[1] 3,222,062	539,351.78	800,374	243,267	385,708	
Dry gold-silver ore	62	18.10	862	261	163	
Dry silver ore	15,802	2,404.74	271,149	5,025	3,884	
Copper ore	[2] 94,577	2,622.82	47,935	1,686,881	709	
Copper-lead ore	120	105.12	2,307	3,471	35,048	
Lead ore	1,471	367.97	28,955	14,567	664,523	
Lead-zinc ore	3,300	32.98	15,461	528	40,702	56,130
Zinc ore	379	.49	167		3,263	265,870
Total, lode mines	3,337,773	544,904.00	1,167,210	1,954,000	1,134,000	322,000
Total, placers		345,526.00	23,902			
	3,337,773	890,430.00	1,191,112	1,954,000	1,134,000	322,000
Total, 1934	2,356,091	719,063.92	844,413	[3] 569,068	823,168	721,719

[1] Includes 40,139 tons of old tailings amalgamated, 731,991 tons of old tailings cyanided, 53,933 tons of old tailings concentrated, and 10,000 tons of old tailings leached.
[2] Includes 5,000 tons of pyrites roasted for the manufacture of sulphuric acid—residue leached.
[3] Includes 80,619 pounds of copper from mine water.

Ore, old tailings, etc., sold or treated in California in 1935, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Alpine	4	8.00	226	29	212	
Amador	[1] 765,245	64,527.16	23,453	6,063	1,235	
Butte	15,050	3,088.23	4,470	221	32	
Calaveras	314,122	26,557.44	8,828	175		
Colusa	400	26.80	9			
Del Norte	2	16.92	2			
Eldorado	317,154	45,260.60	7,762	13,967	543	
Fresno	701	139.18	130	23		
Imperial	15,346	1,234.31	4,142			
Inyo	61,966	17,890.06	5,727	32,880	15,712	
Kern	[1] 257,235	38,731.30	138,040	1,278	4,382	
Lassen	1,323	345.26	395	93	139	
Los Angeles	21,077	5,450.39	5,425	2,278	22	
Madera	1,395	370.09	82			
Mariposa	66,396	13,632.17	6,756	2,335	1,440	
Modoc	4	2.40	11	192		
Mono	5,254	993.55	1,845	468	5,409	
Monterey	6	5.85	1			
Nevada	804,819	240,865.60	519,786	166,113	342,856	
Placer	59,316	11,502.29	17,511	765	565	
Plumas	4,701	1,008.33	316	59		
Riverside	13,002	3,065.83	2,270	1,932	1,392	
Sacramento	21	28.77	44	9	58	
San Bernardino	14,537	3,673.27	10,566	5,030	10,931	
San Diego	532	271.87	89	24		
Santa Cruz	359	14.27	8			
Shasta	236,889	23,144.57	32,204	5,897	209	
Sierra	52,447	18,423.34	4,320	1,128		
Siskiyou	116,218	6,344.17	1,169	600		
Trinity	13,368	5,355.84	1,817	556	249	
Tulare	35	6.74	6			
Tuolumne	59,417	5,911.54	2,643	1,104	180	
Ventura	493	193.79	44			
Yuba	3,228	1,261.85	277	48	142	
	3,222,062	539,351.78	800,374	243,267	385,708	
Total, 1934	2,238,836	441,310.34	542,071	144,963	204,465	

See footnotes at end of table.

Mine production of metals from gold and silver mills in California, 1935–36, by counties, in terms of recovered metals

1935

County	Material treated: Ore	Material treated: Old tailings, etc.	Recovered in bullion: Amalgamation: Gold	Amalgamation: Silver	Cyanidation: Gold	Cyanidation: Silver
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*
Amador	184,295	573,683	32,903.47	8,390	19,210.62	4,466
Butte	14,728		735.00	1,568	1,119.59	142
Calaveras	312,715	1,226	1,970.39	747	17,189.95	3,958
Colusa	400		26.80	9		
Del Norte	2		16.92	2		
Eldorado	261,434		7,131.85	1,366	3,803.24	2,258
Fresno	92	580	121.82	35		
Imperial	610	14,080	104.61	14	957.10	806
Inyo	8,855	840	2,183.63	1,279	46.78	52
Kern	101,117	127,857	8,363.43	2,746	18,245.70	90,046
Lassen	1,110		69.56	167	130.98	53
Los Angeles	20,040		1,232.70	308	2,414.89	3,487
Madera	1,394		355.39	68		
Mariposa	27,570	5,031	6,568.13	1,721	225.83	156
Mono	4,299	1,440	567.42	505	69.06	51,726
Monterey	3		.45			
Nevada	607.806	20,001	180,985.47	137,233	178.07	17,807
Placer	58,795	380	6,340.41	2,182	2,391.77	2,951
Plumas	4,605		887.33	206		
Riverside	12,201	545	633.44	161	1,676.69	1,459
Sacramento	1		1.67			
San Bernardino	8,329	4,740	1,851.38	1,715	642.01	8,066
San Diego	472	50	109.07	23	149.00	51
Santa Cruz	359		11.57	6		
Shasta	234,132	158	1,236.07	285	21,146.50	29,691
Sierra	51,817	10	17,011.07	3,203		
Siskiyou	116,163		5,898.14	1,023		
Trinity	10,703	1,421	4,388.48	853		
Tulare	30		3.94	2		
Tuolumne	27,060	30,120	4,208.76	1,409	13.90	
Ventura	475		145.78	20	24.31	11
Yuba	2,697	168	1,119.71	128		
	2,074,309	782,330	287,183.86	167,374	89,635.99	217,186

County	Concentrates and recovered metal: Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amador	4,176	11,376.48	7,489	2,067	834
Butte	98	1,059.84	2 482	20	
Calaveras	1,850	7,009.40	3,814	60	
Eldorado	11,584	28,042.31	3,228	13,816	502
Inyo	12	38.77	357	128	385
Kern	64	575.70	4,963		
Lassen	2	5.00	1		
Los Angeles	148	743.00	354	482	22
Mariposa	48	174.06	1,405	136	1,433
Mono	43	85.84	591	22	112
Nevada	8,416	25,809.30	95,816	69,145	182,679
Placer	395	2,678.27	12,023	765	467
Plumas	9	23.60	6		
Riverside	15	63.43	8	141	
San Bernardino	12	48.65	32	617	
Santa Cruz	1	2.70	2		
Shasta	131	284.60	118	352	188
Sierra	371	1,283.57	1,013	970	
Siskiyou	122	401.56	79	371	
Trinity	198	584.20	383	36	249
Tuolumne	436	1,301.14	781	898	180
Yuba	4	24.20	6	29	
	28,135	81,615.62	134,951	90,055	187,051

Mine production of metals from gold and silver mills in California, 1935–36, by counties, in terms of recovered metals—Continued

1936

County	Material treated		Recovered in bullion		Concentrates and recovered metal				
	Ore	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amador	245, 688	785, 284	68, 778. 05	14, 740	3, 935	11, 245. 35	5, 765	13, 632	542
Butte	17, 752	--------	2, 972. 26	2, 946	240	2, 281. 59	5, 731	--------	--------
Calaveras	324, 702	9, 831	25, 146. 63	7, 357	29	142. 65	661	--------	1, 013
Eldorado	131, 563	70	13, 384. 16	2, 886	3, 927	12, 922. 72	2, 229	8, 000	--------
Imperial	2, 085	9, 040	895. 40	709	--------	--------	--------	--------	--------
Inyo	7, 431	1, 316	3, 754. 55	10, 862	7	16. 41	13	--------	--------
Kern	238, 254	421, 832	66, 181. 52	368, 634	49	234. 57	403	--------	--------
Los Angeles	13, 745	--------	3, 428. 12	1, 233	111	529. 60	314	1, 021	--------
Madera	6, 153	--------	336. 49	176	2	7. 51	9	--------	--------
Mariposa	45, 497	5, 230	13, 951. 29	2, 981	801	7, 179. 63	2, 502	4, 000	--------
Mono	15, 500	2, 887	1, 432. 21	6, 484	10	23. 26	259	--------	1, 698
Nevada	943, 357	24, 385	214, 508. 31	159, 675	15, 898	54, 442. 28	276, 283	100, 063	246, 184
Placer	52, 170	--------	13, 395. 07	11, 539	288	1, 562. 30	4, 875	--------	1, 367
Plumas	31, 594	--------	4, 089. 54	890	731	3, 359. 67	718	--------	2, 000
Riverside	14, 630	628	5, 046. 48	5, 607	24	82. 21	46	--------	5, 421
San Bernardino	3, 975	11, 437	863. 85	14, 972	16	84. 85	201	241	607
San Diego	419	--------	62. 00	16	--------	--------	--------	--------	--------
Shasta	226, 239	--------	21, 143. 36	27, 506	11	51. 34	49	--------	--------
Sierra	60, 913	--------	17, 823. 91	3, 460	296	1, 124. 82	453	--------	--------
Siskiyou	108, 765	--------	7, 992. 25	1, 207	271	981. 18	207	832	--------
Trinity	10, 784	--------	4, 135. 80	971	29	142. 70	123	--------	--------
Tulare	100	--------	18. 50	6	--------	--------	--------	--------	--------
Tuolumne	38, 442	1	3, 880. 16	991	2, 833	4, 970. 56	2, 287	8, 000	--------
Ventura	275	--------	67. 00	4	--------	--------	--------	--------	--------
Yuba	1, 309	--------	403. 00	97	--------	--------	--------	--------	--------
Combined counties [2]	6, 743	400	1, 027. 81	2, 369	3	1. 25	2	--------	--------
	2, 548, 085	1, 272, 341	494, 717. 72	648, 318	29, 511	101, 386. 45	303, 130	135, 789	258, 832

[2] Includes Fresno, Humboldt, Lassen, Santa Clara, and Stanislaus Counties.

Mine production of metals from concentrating mills in California, 1935–36, by counties, in terms of recovered metals

County	Ore and old tailings treated	Concentrates and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Amador	3,897	96	109.10	289	3,273	63	----------
Eldorado	55,708	2,252	6,079.40	770	53	----------	----------
Imperial	60	3	15.90	7	----------	----------	----------
Inyo	51,385	1,622	14,506.44	3,086	25,093	11,926	----------
Kern	21,007	248	2,923.43	3,619	143	4,382	----------
Lassen	100	6	69.20	96	----------	----------	----------
Mariposa	33,511	348	6,559.85	2,330	577	7	----------
Mono	6,710	119	121.10	45,299	1,278	1,213	----------
Napa	1,920	32	112.20	11,785	445	17	----------
Nevada	175,377	6,201	31,031.73	256,147	67,945	159,142	----------
Orange	3,300	333	32.98	15,461	528	40,702	56,130
Placer	60	3	7.13	1	----------	----------	----------
Plumas	89,524	3,994	2,378.33	47,402	1,653,960	----------	----------
Sacramento	20	1	27.10	44	9	58	----------
San Bernardino	2,998	204	230.12	17,591	588	1,250	----------
Shasta	2,630	189	398.80	2,757	5,862	1,392	----------
Sierra	620	31	128.70	104	158	----------	----------
Trinity	1,230	61	330.91	518	520	----------	----------
Tuolumne	2,050	157	201.54	272	133	----------	----------
Yuba	363	12	117.94	143	19	142	----------
	452,470	15,912	65,381.90	407,721	1,760,584	220,294	56,130
1936							
Amador	1,416	57	499.07	935	2,268	357	----------
Calaveras	12,314	386	2,393.02	985	----------	----------	----------
Eldorado	200,313	11,618	26,979.62	6,157	4,000	----------	----------
Inyo	57,701	1,958	16,119.64	7,398	48,829	16,449	----------
Kern	8,058	220	886.65	764	----------	----------	----------
Nevada	21,512	459	3,315.53	15,619	9,369	29,816	----------
San Bernardino	1,482	104	69.24	1,765	216	21,965	----------
Combined counties [1]	500,769	23,339	15,413.05	811,602	8,489,599	23,308	16,000
	803,565	38,141	65,675.82	845,225	8,554,281	91,895	16,000

[1] Includes Alpine, Butte, Los Angeles, Mono, Napa, Orange, Placer, Plumas, Shasta, Siskiyou, and Yuba Counties.

Gross metal content of California concentrates produced in 1935, by classes of concentrates

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	37,880	137,539.71	324,693	201,774	228,377	----------
Dry silver	323	243.50	78,445	2,422	453	----------
Copper	4,048	2,483.83	51,450	1,711,779	165	----------
Copper-lead	4	1.00	709	422	1,447	----------
Lead	1,566	6,718.34	82,967	68,387	182,450	----------
Zinc	226	11.14	4,408	375	16,010	62,620
	44,047	146,997.52	542,672	1,985,159	428,902	62,620
Total, 1934	27,207	128,244.21	431,206	97,770	151,578	----------

Mine production of metals from California concentrates in 1935, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Amador	4,272	11,485.58	7,778	5,340	897	
Butte	98	1,059.84	2,482	20		
Calaveras	1,850	7,009.40	3,814	60		
Eldorado	13,836	34,121.71	3,998	13,869	502	
Imperial	3	15.90	7			
Inyo	1,634	14,545.21	3,443	25,221	12,311	
Kern	312	3,499.13	8,582	143	4,382	
Lassen	8	74.20	97			
Los Angeles	148	743.00	354	482	22	
Mariposa	396	6,733.91	3,735	713	1,440	
Mono	162	206.94	45,890	1,300	1,325	
Napa	32	112.20	11,785	445	17	
Nevada	14,617	56,841.03	351,963	137,090	341,821	
Orange	333	32.98	15,461	528	40,702	56,130
Placer	398	2,685.40	12,024	765	467	
Plumas	4,003	2,401.93	47,408	1,653,960		
Riverside	15	63 43	8	141		
Sacramento	1	27.10	44	9	58	
San Bernardino	216	278.77	17,623	1,205	1,250	
Santa Cruz	1	2.70	2			
Shasta	320	683.40	2,875	6,214	1,580	
Sierra	402	1,412.27	1,117	1,128		
Siskiyou	122	401.56	79	371		
Trinity	259	915.11	901	556	249	
Tuolumne	593	1,502.68	1,053	1,031	180	
Yuba	16	142.14	149	48	142	
	44,047	146,997.52	542,672	1,850,639	407,345	56,130
Total, 1934	27,207	128,244.21	431,206	69,215	141,523	

BY CLASSES OF CONCENTRATES

Dry gold	37,880	137,539.71	324,693	141,860	216,443	
Dry silver	323	243.50	78,445	1,694	430	
Copper	4,048	2,483.83	51,450	1,658,598	159	
Copper-lead	4	1.00	709	350	1,371	
Lead	1,566	6,718.34	82,967	47,862	173,789	
Zinc	226	11.14	4,408	275	15,153	56,130
	44,047	146,997.52	542,672	1,850,639	407,345	56,130

Gross metal content of California crude ore shipped to smelters in 1935, by classes of ore

Class of ore	Ore	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	17,917	17,745.21	68,354	57,934	34,478	
Dry gold-silver	62	18.10	862	373	172	
Silver	3,785	2,127.12	139,988	4,098	3,598	
Copper	53	244.49	532	7,452	778	
Copper-lead	60	104.12	1,598	4,801	35,081	
Lead	1,391	331.37	28,082	21,087	697,859	
Zinc	331					247,483
	23,599	20,570.41	239,416	95,745	771,966	247,483
Total, 1934	25,615	17,149.89	211,773	126,168	734,346	758,885

Mine production of metals from California crude ore shipped to smelters, 1935–36, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Alpine	4	8.00	226	29	212	-
Amador	3,379	938.09	2,860	1,242	338	-
Butte	322	173.80	278	201	32	-
Calaveras	243	405.80	1,171	376	163	-
Eldorado	3	74.60	11	-	-	-
Fresno	29	17.36	95	23	-	-
Imperial	596	156.70	3,315	-	-	-
Inyo	2,818	1,507.16	33,476	24,391	675,540	235,109
Kern	7,940	8,615.83	45,820	1,693	-	-
Lassen	113	70.52	78	93	139	-
Los Angeles	1,038	1,060.30	1,279	1,803	208	-
Madera	1	14.70	14	-	-	-
Mariposa	284	104.30	1,144	1,622	-	-
Modoc	4	2.40	11	192	-	-
Mono	237	238.47	2,929	463	5,137	-
Monterey	3	5.40	1	-	-	-
Nevada	1,634	2,616.01	12,712	28,962	592	-
Placer	80	84.51	354	-	98	-
Plumas	96	97.40	104	59	-	-
Riverside	287	706.18	1,079	3,654	14,725	-
San Bernardino	4,165	3,238.89	132,008	11,724	25,576	-
San Diego	10	13.80	15	24	-	-
Shasta	33	79.80	77	33	-	-
Siskiyou	55	44.47	67	229	-	-
Trinity	16	95.72	166	25	148	-
Tulare	5	2.80	4	-	-	-
Tuolumne	186	173.70	109	73	-	-
Ventura	18	23.70	13	-	-	-
	23,599	20,570.41	239,416	76,911	722,908	235,109

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
1935						
Dry gold	17,917	17,745.21	68,354	49,131	31,580	-
Dry gold-silver	62	18.10	862	261	163	-
Silver	3,785	2,127.12	139,988	3,331	3,454	-
Copper	53	244.49	532	6,630	709	-
Copper-lead	60	104.12	1,598	3,121	33,677	-
Lead	1,391	331.37	28,082	14,437	653,325	-
Zinc	331	-	-	-	-	235,109
	23,599	20,570.41	239,416	76,911	722,908	235,109

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
1936						
Amador	34	98.53	94	100	1,101	-
Calaveras	460	422.70	3,874	-	2,987	-
Inyo	2,302	591.40	33,231	23,171	539,551	-
Kern	1,477	414.26	11,739	-	-	-
Los Angeles	225	226.57	776	979	-	-
Mariposa	61	43.08	136	-	-	-
Mono	161	70.53	2,683	1,569	29,627	-
Nevada	644	406.88	1,316	24,568	-	-
Placer	44	338.13	131	-	-	-
Riverside	198	641.31	566	-	579	-
San Bernardino	5,585	1,880.06	218,388	21,543	39,428	-
Shasta	53	116.30	410	-	-	-
Siskiyou	90	203.07	91	-	-	-
Trinity	22	38.50	26	-	-	-
Tuolumne	47	61.28	50	-	-	-
Combined counties [1]	297	686.41	534	-	-	-
	11,700	6,239.01	274,045	71,930	613,273	-

[1] Includes Butte, Eldorado, Fresno, Humboldt, Imperial, Lassen, Merced, Plumas, Stanislaus, and Yuba Counties.

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in California in 1935, by counties and districts, in terms of recovered metals

County and district	Mines producing [1]		Ore, old tailings, etc.	Gold			Silver (lode and placer) [2]	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Alameda County: Alma	(3)		(3)					(3)			(3)
Alpine County: Monitor	(3)		(3)	(3)		(3)	(3)	(3)	(3)		(3)
Amador County:											
Consumnes River drainage		(4)			39.12	39.12					$1,369
Dry Creek drainage		(4)			324.01	324.01					11,340
East Belt [5]	17	9	3,992	1,384.68	241.88	1,626.56	4,686	5,009	497		60,734
Jackson Creek		(4)			167.65	167.65					5,868
Lancha Plana		2			1,015.29	1,015.29	99				35,606
Mokelumne River drainage					275.09	275.09					9,628
Mother Lode [6]	35	24	758,379	62,246.76	7,641.81	69,888.57	19,487	1,573	738		2,460,267
North Fork Consumnes River					6.24	6.24					218
Sutter Creek drainage					325.64	325.64					11,397
Unallocated [7]	(4)	(4)	2,883	906.32	117.93	1,024.25	262				36,037
Butte County:											
Butte Creek drainage		3			122.23	122.23	10				4,285
Cherokee	1	4	40	10.52	249.34	259.86	12				9,104
Chico		(4)			18.98	18.98					664
Enterprise		1			9.97	9.97	1				350
Feather River drainage		(4)			1,007.95	1,007.95					35,278
Forbestown	4	5	440	83.24	166.88	250.12	11				8,762
Forks of Butte		(4)			426.04	426.04					14,911
Golden Summits		(4)			26.43	26.43					925
Honcut Creek		(4)			201.00	201.00					7,035
Magalia	6	15	1,156	201.01	1,767.56	1,968.57	238				69,071
Merrimac		4			18.02	18.02	2				632
Oroville	12	31	1,432	384.66	17,361.92	17,746.58	1,373	201	32		622,135
Palermo		5			2,400.31	2,400.31	146				84,116
Stirling City		4			53.15	53.15	5				1,864
Yankee Hill	6	4	11,982	2,408.80	282.01	2,690.81	4,125	20			97,144
Unallocated [7]		(4)			18.05	18.05					632
Calaveras County:											
Calaveras River drainage		(4)			140.12	140.12					4,904
Camanche		5			6,994.80	6,994.80	614				245,259
Campo Seco		4			118.02	118.02	17				4,143
Copperopolis		2			7.67	7.67	1				269
East Belt [5]	24	5	30,517	3,317.04	90.18	3,407.22	2,246	175			120,881
Jenny Lind	4	5	3,249	1,646.93	2,907.34	4,554.27	1,521				160,493
Middle Fork Mokelumne River drainage		(4)			117.99	117.99					4,130

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1935, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore, old tailings, etc.	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Calaveras County—Continued.											
Mother Lode [6]	30	34	280,218	21,555.71	8,483.63	30,039.34	7,027	261	163		$1,056,456
North Fork Calaveras River drainage		(4)			85.88	85.88					3,006
North Fork Mokelumne River drainage		(4)			14.51	14.51					508
North Fork Stanislaus River drainage		(4)			83.18	83.18					2,911
South Fork Calaveras River drainage		(4)			44.36	44.36					1,553
Stanislaus River drainage		(4)			104.37	104.37					3,653
Unallocated [7]	(4)	(4)	200	55.86	153.61	209.47	8				7,337
Colusa County: Wilbur Springs	1		400	26.80		26.80	9				944
Del Norte County:											
Big Flat		(4)			.53	.53					19
Craig Creek drainage		(4)			12.28	12.28					430
Crescent City		(4)			2.07	2.07					72
French Hill	1	5	2	16.92	53.07	69.99	5				2,453
Low Divide		(4)			1.07	1.07					37
Monumental		(4)			.66	.66					23
Smith River drainage		4			50.48	50.48					1,767
Eldorado County:											
American River drainage		(4)			113.27	113.27					3,964
Consumnes River drainage		(4)			79.40	79.40					2,779
East Belt [5]	8	22	532	212.83	188.65	401.48	163	7	395		14,185
Garden Valley		(4)			10.09	10.09					353
Middle Fork American River drainage		(4)			116.00	116.00					4,060
Middle Fork Consumnes River drainage		(4)			1.99	1.99					70
Mother Lode [6]	53	191	284,846	41,180.63	4,723.33	45,903.96	5,732	13,882	148		1,611,917
North Fork American River drainage		(4)			13.61	13.61					476
North Fork Consumnes River drainage		(4)			103.48	103.48					3,622
Rescue	(3)	12	(3)	(3)	80.50	[8] 80.50	[8] 7	(3)			[8] 2,823
Rubicon River drainage		(4)			35.97	35.97					1,259
South Fork American River drainage		(4)			485.76	485.76					17,002
South Fork Consumnes River drainage		(4)			11.83	11.83					414
Webber Creek drainage		(4)			153.03	153.03					5,356
Unallocated [7]		2			147.30	147.30	1				5,156
Fresno County:											
Auberry		2			2.23	2.23					78
Big Creek		(4)			1.04	1.04					36
Copper King	2		51	6.06		6.06					212
Davis Flat	1		1	1.20		1.20					42
Dinkey Creek		(4)			1.04	1.04					36
Friant	1	3	580	87.09	198.55	285.64	58				10,039
Kings River drainage		(4)			4.68	4.68					164

Mill Creek	1		29	15.52		15.52	5				547
San Joaquin		(4)			209.01	209.01					7,315
Sycamore	2	2	3	6.74	16.16	22.90	7	8			807
Temperance Flat	3	1	37	22.57	.64	23.21	96	15			883
Unallocated [7]		2			17.33	17.33					607
Glenn County: Hambright Creek		(4)			.06	.06					2
Humboldt County:											
Cedar		1			12.52	12.52	2				440
China Flat		(4)			.11	.11					4
Elk River drainage		(4)			25.62	25.62					897
Gold Bluff		(4)			42.90	42.90	3				1,504
Hoopa		5			23.95	23.95	4				841
Klamath River drainage		(4)			97.27	97.27					3,404
Little River		(4)			.10	.10					4
Mad River drainage		(4)			.15	.15					5
Ocean Beach		(4)			.05	.05					2
Orick		(4)			12.37	12.37					433
Orleans		21			674.64	674.64	89				23,676
Scotia		(4)			.19	.19					7
Trinity River drainage		(4)			4.58	4.58					160
Weitchpec		(4)			1.72	1.72					60
Willow Creek drainage		2			2.87	2.87					100
Unallocated [7]		2			6.01	6.01					210
Imperial County:											
Alamo River		(4)			.09	.09					3
Cargo Muchacho	8	(4)	14,677	1,173.05	10.31	1,183.36	4,138				44,391
Chocolate Mountains		1			6.30	6.30					221
Hedges	1		309	10.88		10.88	1				382
Mesquite	1	(4)	50	14.50	133.09	147.59					5,166
Picacho		1			83.06	83.06					2,907
Potholes	2	2	310	35.88	222.59	258.47	8				9,052
New River		(4)			1.03	1.03					36
Unallocated [7]		(4)			6.54	6.54					229
Inyo County:											
Alabama Hills	2		75	25.21		25.21	24				899
Carbonate	5		365	98.99		98.99	2,998	471	75,534		8,680
Cerro Gordo	11	(4)	5,803	596.74	2.71	599.45	25,143	13,763	486,341	265,870	71,347
Chidago	5		50,224	14,464.30		14,464.30	2,793	24,441	3,826		510,440
Chloride Cliff	6		289	386.45		386.45	1,863	287	28,836		16,042
Coso	4		272	35.62		35.62	21	11			1,263
Darwin	2	1	380	33.29	2.26	35.55	566				1,651
Death Valley		(4)			1.14	1.14					40
Fish Springs	6		1,290	216.57		216.57	589	1,012	4,250		8,257
Harrisburg	1		12	.80		.80	420	934	667		434
Lone Pine	1	1	50	19.68	4.27	23.95	4				841
Modoc	8	(3)	88	40.19	(3)	[9] 40.19	[9] 25				[9] 1,425
Mount Argus	3		1,052	145.38		145.38	29	95	608		5,141
Owens River		(4)			.24	.24					8
Panamint		1			7.38	7.38					258
Slate Range	1		45	24.09		24.09	312	90	62,297		3,567
South Park	10		1,276	589.41		589.41	810	6,157	2,813		21,835

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1935, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore, old tailings, etc.	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
Inyo County—Continued.			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Union	4	3	591	320.18	15.75	335.93	1,950	2,123	25,482		$14,355
White Mountains	5		821	304.94		304.94	263	208	385		10,895
Wildrose	4		1,287	966.21		966.21	450				34,141
Unallocated [7]	(4)	1	26	15.22	2.26	17.48	160	20	75		731
Kern County:											
Agua Caliente	5	(4)	666	219.81	5.86	225.67	97				7,968
Black Mountain		1			23.98	23.98					839
Buena Vista		(4)			1.09	1.09					38
China Grade		1			84.59	84.59	13				2,970
Clear Creek	5	(4)	641	327.44	.90	328.34	162				11,608
Cove	1	(4)	20,400	2,794.51	.43	2,794.94	2,461		4,382		99,767
Goler	2	2	90	3.54	103.49	107.03	3				3,748
Greenhorn Mountains	18	4	610	361.90	36.54	398.44	749	162			14,497
Kern River drainage		1			13.79	13.79	1				483
Long Tom	3	1	63	54.62	26.13	80.75	22				2,842
Mojave	45	(4)	46,747	23,664.34	1.90	23,666.24	132,920	1,664			923,993
Pioneer	16	4	457	123.87	11.88	135.75	272				4,947
Poso Creek		(4)			1.90	1.90					67
Rademacher	3	1	387	201.58	8.06	209.64	3,764				10,043
Randsburg [10]	40	20	187,368	10,995.81	533.11	11,528.92	6,901	10			408,473
Red Rock	2	1	203	33.39	8.34	41.73	30				1,482
Tehachapi	1		116	20.67		20.67	14				734
Valley View		(4)			2.42	2.42					85
Woody	2	(3)	176	26.02	(3)	[9] 26.02	[9] 15				[9] 921
Unallocated [7]		(4)			.70	.70					25
Kings County: Banner		(4)			2.37	2.37					83
Lake County:											
Middletown		(4)			.19	.19					7
Morton Valley		(4)			1.66	1.66					58
Lassen County:											
Clinton		(4)			.16	.16					6
Hayden Hill	4	(4)	1,323	345.26	2.25	347.51	396	93	139		12,461
Unallocated [7]		(4)			.40	.40					14
Los Angeles County:											
Castaic		(4)				5.27					184
Cedar	3		2,816	874.44	5.27	874.44	274	27			30,805
Neenach	3		4,248	3,463.59		3,463.59	4,764	1,796	22		124,800
Pacoima Canyon	1		2,013	200.32		200.32	55				7,051
Palmdale	1	1	1	.50	1.11	1.61	3	7	208		67
Piru		(4)			24.92	24.92					872
San Gabriel	4	10	800	135.47	325.78	461.25	63				16,189

Saugus		5			403.56	403.56	288				14,332
Sierra Polomas		(4)			2.11	2.11					74
Tejunga River drainage		(4)			10.20	10.20					357
Valyermo	(3)		(3)	(3)		(3)	(3)	(4)			(3)
Unallocated 7		3			44.87	44.87	11				1,578
Madera County:											
Chowchilla River drainage		(4)			92.07	92.07					3,222
Coarsegold		(4)			.12	.12					4
Daulton		4			7.64	7.64	2				269
Fresno River drainage		(4)			15.25	15.25					534
Hildreth	7	4	40	16.75	12.11	28.86	13				1,019
Madera		1			.35	.35					12
North Fork San Joaquin River drainage		(4)			4.22	4.22					148
Potter Ridge	12	12	1,355	353.34	92.34	445.68	100				15,671
San Joaquin River drainage		(4)			7.23	7.23					253
Unallocated 7		(4)			10.30	10.30	1				361
Mariposa County:											
Bear Creek drainage		(4)			22.14	22.14					775
Chowchilla River drainage		(4)			1.38	1.38					48
Colorado	11	3	752	446.09	22.89	468.98	83				16,474
Hites Cove	8		1,604	409.71		409.71	141	10	29		14,443
Hunter Valley	17	7	6,412	562.81	64.22	627.03	333	56			22,190
Kinsley	(3)		478	191.21		191.21	97	7	51		6,765
Mariposa Creek drainage		(4)			60.37	60.37					2,113
Merced River drainage		(4)			141.16	141.16					4,941
Mother Lode 6	42	31	42,145	8,133.77	490.07	8,623.84	5,484	2,181	1,360		306,011
North Fork Merced River drainage		(4)			15.99	15.99					560
Owens Creek drainage		(4)			10.42	10.42					365
Quartzburg	9		1,161	197.26		197.26	83	81			6,970
South Fork Merced River drainage		(4)			9.05	9.05					317
Whitlock	5	1	13,844	3,691.32	7.20	3,698.52	612				129,888
Unallocated 7		1			224.21	224.21	2				7,849
Merced County:											
Chowchilla River drainage		(4)			2.47	2.47					86
Merced River drainage		(4)			52.53	52.53					1,839
Mariposa Creek drainage		(4)			.59	.59					21
Snelling		4			37,153.57	37,153.57	3,841				1,303,136
Unallocated 7		(4)			1.38	1.38					48
Modoc County:											
Fort Bidwell	1		1					192			16
Willow Ranch	1		3	2.40		2.40	11				92
Mono County:											
Blind Springs Hill	3		11	1.23		1.23	742	128	2,645		693
Bodie	10		2,812	790.49		790.49	1,356	357	2,492		28,771
Chidago	7	(4)	309	116.87	3.16	120.03	830		112		4,802
Dogtown Diggings		2			2.77	2.77					97
Homer		2			18.82	18.82	5				662
Mono Lake	2	(4)	2,157	99.02	14.25	113.27	126	49	800		4,091
Oasis		1			1.39	1.39					49
Patterson	1	2	7,397	74.28	16.16	90.44	97,997	1,229	413		73,719
Virginia Creek drainage		(4)			4.24	4.24					148

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1935, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore, old tailings, etc.	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Monterey County: Los Burros	2	2	6	5.85	2.63	8.48	1				$298
Napa County:											
Calistoga	1	(4)	1,920	112.20	1.44	113.64	11,785	445	17		12,485
Napa River		(4)			.20	.20					7
Nevada County:											
Banner		(4)			483.11	483.11					16,909
Canada Hill	1		473	237.75		237.75	170	33	230		8,455
French Corral	3	23	46,885	6,734.48	873.37	7,607.85	71,150	47,479	136,816		326,827
Grass Valley-Nevada City	25	54	725,629	227,640.59	1,679.87	229,320.46	363,129	74,535	99,892		8,297,397
Middle Yuba		(4)			659.74	659.74					23,090
North Bloomfield		(4)			105.60	105.60					3,696
North Columbia		(4)			55.54	55.54					1,944
North San Juan		(4)			427.66	427.66					14,968
Rough and Ready		(4)			25.82	25.82					904
South Yuba River drainage		(4)			699.92	699.92					24,497
Washington	9	26	31,822	6,249.91	1,845.67	8,095.58	85,784	44,066	105,918		352,897
You Bet	1	6	10	2.87	2,874.75	2,877.62	129				100,809
Yuba River drainage		(4)			239.31	239.31					8,376
Unallocated [7]		(4)			166.88	166.88					5,841
Orange County: Santa Rosa	(3)		(3)	(3)		(3)	(3)	(3)	(3)	(3)	(3)
Placer County:											
American River drainage		(4)			943.29	943.29					33,015
Auburn	3	18	741	288.28	6,290.47	6,578.75	842		13		230,863
Bald Mountain		1			1.31	1.31					46
Bear River drainage		(4)			705.06	705.06					24,677
Butcher Ranch	3	4	7	41.57	30.29	71.86	3				2,517
Canyon Creek drainage		(4)			59.11	59.11					2,069
Colfax	4		332	121.85		121.85	307		85		4,489
Dairy Farm	1	(4)	31,125	2,391.77	.94	2,392.71	2,951				85,866
Dutch Flat	3	11	1,916	1,895.84	374.45	2,270.29	448	299			79,807
Foresthill	4	23	1,886	541.06	1,270.70	1,811.76	233				63,579
Gold Run		2			1,294.70	1,294.70	166				45,434
Iowa Hill	2	25	151	15.20	700.22	715.42	66				25,087
Last Chance	3	13	552	149.02	1,043.58	1,192.60	141				41,842
Michigan Bluff	2	9	1,332	285.68	154.16	439.84	62				15,439
Middle Fork American River drainage		(4)			370.44	370.44					12,965
North Fork American River drainage		(4)			813.77	813.77					28,482
Ophir	13	6	21,123	5,753.24	557.04	6,310.28	13,711	448	467		230,770
Ralston Divide		2			1.03	1.03					36
Rock Creek	1	(4)	151	18.78	27.38	46.16	8	18			1,623

Rubicon River drainage		(4)			2.26	2.26					79
Soda Springs		1			43.93	43.93	3				1,540
South Fork American River drainage		(4)			33.27	33.27					1,164
Unallocated [7]		(4)			217.72	217.72					7,620
Plumas County:											
Bucks Creek		(4)			1.13	1.13					40
Butte Valley	5	13	160	39.94	400.56	440.50	69				15,467
Crescent Mills	9	15	2,588	404.99	344.01	749.00	223	59			26,380
East Fork Feather River drainage		(4)			3.49	3.49					122
Feather River drainage		(4)			95.22	95.22					3,333
Genesee	(3)	6	(3)	(3)	52.43	[6] 52.43	[8] 6	(3)			[8] 1,839
Granite Basin	2	7	75	16.45	55.77	72.22	8				2,533
Johnsville	3	6	520	100.53	31.69	132.22	18				4,641
La Porte	1	6	1,084	411.50	191.99	603.49	106				21,198
Lights Canyon		1			93.84	93.84	12				3,293
Middle Fork Feather River drainage		(4)			476.33	476.33					16,672
North Fork Feather River drainage		(4)			401.52	401.52					14,053
Onion Valley		1			2.15	2.15					75
Quincy	4	22	272	30.23	188.66	218.89	20				7,676
Rock Creek drainage		(4)			15.03	15.03					526
Rush Creek drainage		(4)			37.29	37.29					1,305
Sawpit	1		2	4.69		4.69					164
Slate Creek drainage		(4)			46.57	46.57					1,630
South Fork Feather River drainage		(4)			35.93	35.93					1,258
Virgilia		(4)			1.57	1.57					55
Unallocated [7]		(4)			76.90	76.90					2,692
Riverside County:											
Bendigo	1		1,505	133.38		133.38		939			4,746
Chuckawalla	4	4	859	462.51	63.48	525.99	232	769	1,392		18,696
Dale		1			1.28	1.28					45
Eagle Mountain	4	3	46	53.57	27.48	81.05	15				2,848
Ironwood	2	1	361	119.28	.29	119.57	58	218			4,245
Monte Negro	4		6,288	1,747.29		1,747.29	2,204	1,869	13,333		63,428
Pinacate	9	1	2,507	171.71	20.07	191.78	85				6,773
Pinon	15		1,466	385.50		385.50	122				13,580
Tanquitz		1			3.32	3.32					116
Washington		1			5.24	5.24					183
Unallocated [7]	(4)	(4)	1	6.50	.73	7.23	1				254
Sacramento County:											
Consumnes River drainage		(4)			21.76	21.76					762
Deer Creek drainage		(4)			14.60	14.60					511
Dry Creek drainage		(4)			.66	.66					23
Folsom	2	16	21	28.77	113,626.93	113,655.70	4,400	9	58		3,981,115
North Fork American River drainage		(4)			35.08	35.08					1,228
Sacramento River drainage		(4)			15.02	15.02					526
Unallocated [7]		(4)			85.30	85.30					2,986
San Bernardino County:											
Atolia	1		27	2.17		2.17	1				77
Barstow	6	2	542	144.05	3.18	147.23	94	214	49		5,240
Bear Valley		1			11.00	11.00					385
Black Hawk	1	2	13	26.87	8.71	35.58	110	92	2,067		1,415

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1935, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore, old tailings, etc.	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
San Bernardino County—Continued.											
Bristol	1		50	2.87		2.87	2				$102
Buckeye	(3)	1	(3)	(3)	4.46	[8] 4.46	(3)				[8] 156
Calico	6	2	3,946	81.50	35.29	116.79	7,808	130	13,539		10,252
Coolgardie		(3)			(3)	(3)	(3)				(3)
Dale	5	3	874	573.06	15.28	588.34	678	1,517			21,205
Dry Lake	2		164	51.58		51.58	19	77			1,825
Goldstone		1			.41	.41					14
Grapevine		(4)			23.00	23.00					805
Halloran Springs	1		44	16.81		16.81	113				670
Hart	1		515	131.05		131.05	32				4,610
Holcomb	1	10	35	9.00	128.73	137.73	5				4,824
Ivanpah	8		1,509	558.49		558.49	3,108	2,928	2,935		22,141
Kelso	2		1,415	1,026.43		1,026.43	166	183			36,060
Lytle Creek	1	2	5	.30	8.49	8.79	165		237		436
Mojave Desert		(4)			7.35	7.35					257
Monumental	3		56	44.42		44.42	97	10	129		1,630
Morrow		1			9.48	9.48	1				333
Needles	3	(4)	135	76.60	4.16	80.76	247	252	4,808		3,217
Old Woman Mountains	9		209	221.56		221.56	625	17			8,205
Ord Mountain	4	1	74	26.28	58.67	84.95	16	17			2,986
Paradise	2		320	40.69		40.69	3				1,426
Providence	4	(4)	110	44.34	10.16	54.50	38	89			1,942
Randsburg [10]	12	3	7,700	2,313.77	1,104.78	3,418.55	145,130	2,494	212		224,177
San Gregorio		1			2.33	2.33					82
Shadow Mountains	1		75	21.60		21.60	10				763
Signal	2		81	34.94		34.94	393	25	678		1,535
Silver Lake	1		45	9.00		9.00	5				319
Silver Mountain	14		1,055	256.26		256.26	492	1,515	1,351		9,503
Slate Range	6	2	552	143.93	20.88	164 81	181	32	821		5,934
Soda Lake	1		300	20.15		20.15	15				716
Spangler	1		8	16.22		16.22	12				576
Twentynine Palms	1	2	2	1.90	20.21	22.11					774
Turtle Mountain	1		9	24.32		24.32	3				853
Washington	1		3	1.04		1.04	1				37
Whipple Mountain	8		106	77.55		77.55	36	3,337			3,017
Unallocated [7]	1	(4)	76	13.87	438.82	452.69	13				15,853
San Diego County:											
El Cajon	3		48	24.96		24.96	3				876
Julian	8	1	484	246.91	24.33	271.24	87	24			9,558

San Joaquin County:											
Belota		(4)			18.23	18.23	1				639
Calaveras River drainage		(4)			1.03	1.03					36
Clements		2			2,825.84	2,825.84	150				99,013
Mokelumne River drainage		(4)			.58	.58					20
San Joaquin River drainage		(4)			.82	.82					29
Unallocated [7]		(4)			2.00	2.00					70
San Luis Obispo County:											
Cambria		(4)			6.40	6.40					224
La Panza		(4)			1.17	1.17					41
Unallocated [7]		(4)			.62	.62					22
Santa Cruz County:											
Empire Grade	2		359	14.27		14.27	8				505
Santa Cruz		(4)			2.91	2.91					102
Unallocated [7]		(4)			.45	.45					16
Shasta County:											
Beegum Creek drainage		(4)			12.25	12.25					429
Centerville	2	7	1,094	287.82	96.68	384.50	143	230	188		13,587
Clear Creek		8			239.35	239.35	14				8,387
Cottonwood Creek	1	2	40	31.15	504.29	535.44	30				18,762
Cow Creek drainage		(4)			9.29	9.29					325
Flat Creek	4		1,230	270.03		270.03	1,878	5,207	21		11,234
French Gulch	13	6	5,143	879.04	99.48	978.52	199	115			34,401
Harrison Gulch		1			2.94	2.94					103
Igo	1	3	46	8.56	131.12	139.68	19				4,902
Iron Mountain	(3)		(3)	(3)		(3)	(3)				(3)
Little Cow Creek drainage		(4)			71.21	71.21					2,492
Little Sacramento River drainage		(4)			16.23	16.23					568
McCloud River drainage		(4)			.52	.52					18
Muletown	9	9	2,571	280.56	1,542.20	1,822.76	322	316			64,054
Ono	1	1	1	4.00	15.66	19.66	4				691
Pit River drainage		(4)			14.77	14.77					517
Sacramento River drainage		(4)			828.85	828.85					29,010
Shasta	8	7	769	238.11	173.54	411.65	821	379	1,371		15,084
Squaw Creek drainage		(4)			13.48	13.48					472
Unallocated [7]		(4)			580.89	580.89					20,331
Sierra County:											
Alleghany	9	26	49,730	18,091.20	593.10	18,684.30	4,264	1,117			657,108
American Hill	(3)		(3)	(3)		(3)	(3)				(3)
Canyon Creek drainage		(4)			79.33	79.33					2,777
Deer Creek drainage		(4)			.44	.44					15
Downieville	5	35	550	43.16	601.22	644.38	74				22,606
East Fork Yuba River drainage		(4)			29.14	29.14					1,020
Gibsonville		3			204.82	204.82	12				7,177
Gold Lake	1	1	30	4.01	85.87	89.88	12				3,154
Indian Hill		10			636.69	636.69	47				22,318
Middle Fork Yuba River drainage		(4)			1,839.56	1,839.56					64,385
North Fork Yuba River drainage		(4)			1,032.80	1,032.80					36,148
Pike	1	3	380	20.57	191.18	211.75	18				7,424
Port Wine		3			32.12	32.12	2				1,126
Rock Creek		(4)			1.14	1.14					40

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1935, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore, old tailings, etc.	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Sierra County—Continued.											
Sierra City	3	2	1,715	251.65	16.38	268.03	102	11			$9,455
Slate Creek drainage		(4)			27.76	27.76					972
South Fork Yuba River drainage		(4)			17.25	17.25					604
Yuba River drainage		(4)			222.65	222.65					7,793
Siskiyou County:											
Ash Creek		1			4.33	4.33					152
Callahan		(3)			(3)	(3)	(3)				(3)
Deadwood		1			9.32	9.32	1				327
Dunsmuir	1		16	1.36		1.36					48
Elliott Creek	2	3	33	32.36	422.55	454.91	84				15,982
Klamath River	4	35	78	47.50	1,494.04	1,541.54	126				54,044
McCloud River drainage		(4)			.45	.45					16
North Central	21	35	5,833	1,613.47	5,275.76	6,889.23	928	579			241,838
Salmon River	15	57	104,766	3,319.02	2,247.10	5,566.12	576	21			195,230
Scott River	11	17	5,492	1,330.46	635.85	1,966.31	524				69,197
Shasta River		1			2.68	2.68					94
Sonoma County:											
Gualala		(4)			.94	.94					33
Jackson Creek drainage		(4)			.32	.32					11
Mill Creek drainage		(4)			.12	.12					4
San Antonio Creek drainage		(4)			.23	.23					8
Unallocated [7]		(4)			7.46	7.46					261
Stanislaus County:											
Ceres		(4)			2.43	2.43					85
Dry Creek drainage		(4)			.13	.13					5
Knights Ferry		1			32.19	32.19	2				1,128
La Grange		3			8,162.71	8,162.71	1,049				286,449
Oakdale		4			144.30	144.30	13				5,060
Stanislaus River drainage		(4)			13.27	13.27					464
Tuolumne River drainage		(4)			.90	.90					32
Unallocated [7]		(4)			19.17	19.17					671
Sutter County:											
Bear River drainage		(4)			1.50	1.50					53
Buttes		(4)			1.56	1.56					55
Feather River drainage		(4)			.05	.05					2
Marysville Buttes		(4)			2.61	2.61					91
Sacramento River drainage		(4)			.32	.32					11
Unallocated [7]		(4)			4.15	4.15					145

Tehama County:											
Sacramento River drainage		(4)			4.45	4.45					156
South Fork Sacramento River		(4)			.35	.35					12
Unallocated [7]		(4)			.27	.27					9
Trinity County:											
Big Bar		9			223.43	223.43	6				7,824
Burnt Ranch		4			69.98	69.98	6				2,454
Coffee Creek	11	14	5,087	1,178.30	208.62	1,386.92	806	534	148		49,172
East River		(4)			3.01	3.01					105
Forest Glen		1			2.97	2.97					104
Hayfork		16			319.40	319.40	24				11,196
Helena	1	8	2,172	1,490.25	650.48	2,140.73	563	36	249		75,343
Junction City	6	7	367	72.46	3,668.86	3,741.32	435	11			131,260
Lewiston	5	9	5,494	2,563.76	4,583.78	7,147.54	1,132				250,978
New River	4	20	226	55.03	3,795.36	3,850.39	439				135,079
Salyer	1	(3)	4	3.33	(3)	[9] 3.33	[9] 1				[9] 117
Trinity Center	1	4	20	36.18	628.16	664.34	7				23,257
Weaverville		13			1,155.61	1,155.61	64				40,492
Unallocated [7]		(4)			72.78	72.78	3				2,549
Tulare County:											
Bear Mountain	1		30	3.94		3.94	2				139
California Hot Springs	1		5	2.80		2.80	4				101
Mill Creek drainage		(4)			2.00	2.00					70
White River		2			18.47	18.47	7				651
Tuolumne County:											
Big Creek drainage		(4)			10.56	10.56					370
Columbia	32	17	6,422	2,206.41	262.71	2,469.12	656	669	166		86,953
East Belt [5]	26	20	42,364	2,514.66	82.64	2,597.30	1,290	21			91,834
Middle Fork Stanislaus River		(4)			8.99	8.99					315
Moccasin Creek drainage		(4)			39.22	39.22					1,373
Mormon Creek drainage		(4)			1.28	1.28					45
Mother Lode [6]	21	55	10,631	1,190.47	976.34	2,166.81	807	414	14		76,453
North Fork Stanislaus River drainage		(4)			5.85	5.85					205
North Fork Tuolumne River drainage		(4)			9.04	9.04					316
South Fork Stanislaus River drainage		(4)			26.42	26.42					925
South Fork Tuolumne River drainage		(4)			59.68	59.68					2,089
Stanislaus River drainage		(4)			225.08	225.08					7,878
Tuolumne River drainage		(4)			155.79	155.79					5,453
Woods Creek drainage		(4)			358.87	358.87					12,560
Unallocated [7]		(4)			39.18	39.18					1,371
Ventura County:											
Old Pine	1		28	29.41		29.41	17				1,042
Piru	3		465	164.38		164.38	27				5,773
Yolo County:											
Sacramento River drainage		(4)			13.98	13.98					489
Winters		1			6.46	6.46					226
Yuba County:											
Bear River drainage		(4)			90.22	90.22					3,158
Brown Valley		(4)			.97	.97					34
Brownsville		3			154.59	154.59					5,411
Camptonville	1	15	50	29.04	293.15	322.19	35				11,302

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1935, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore, old tailings, etc.	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Yuba County—Continued.											
Dobbins	2	7	1,572	364.88	299.31	664.19	58				$23,288
Dry Creek drainage		(4)			76.91	76.91					2,692
Honcut Creek drainage		(4)			7.33	7.33					257
Middle Fork Yuba River		(4)			21.77	21.77					762
North Fork Yuba River		(4)			615.23	615.23					21,533
Oregon Creek drainage		(4)			131.95	131.95					4,618
Smartville		7			970.42	970.42	65				34,011
South Fork Yuba River		(4)			12.71	12.71					445
Strawberry Valley	4	6	1,506	798.73	120.01	918.74	132	39			32,254
Yuba River drainage		3	100	69.20	47,524.30	47,593.50	3,461	9	142		1,668,267
Unallocated [7]		1			29.41	29.41					1,029
Undistributed [11]	11	8	367,084	28,246.10	545.93	28,792.03	95,489	1,681,341	40,914	56,130	1,220,011
Total California	1,112	1,487	3,337,773	544,904.00	345,526.00	890,430.00	[2] 1,191,112	1,954,000	1,134,000	322,000	32,242,872

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Of total silver, 1,167,209 ounces were from lode mines and 23,903 ounces from placers.
[3] Included under "Undistributed."
[4] No information as to number (see footnote 1).
[5] East Belt district lies in Amador, Calaveras, Eldorado, Mariposa, and Tuolumne Counties.
[6] Mother Lode district lies in Amador, Calaveras, Eldorado, Mariposa, and Tuolumne Counties.
[7] No information as to district of origin.
[8] Exclusive of lode output, which is included under "Undistributed."
[9] Exclusive of placer output, which is included under "Undistributed."
[10] Randsburg district lies in both Kern and San Bernardino Counties.
[11] Includes items entered as "(3)" above.

ALPINE COUNTY

Mogul-Monitor district.—The Zaca Mining Corporation operating the Zaca mine in 1936 milled a small quantity of gold-silver ore and shipped the concentrate for smelting.

AMADOR COUNTY

East Belt district.—The Amador Columbus Co. worked the Amador Columbus mine during the last 3 months of 1936. The Wiljobar Corporation developed the Defender mine in the Volcano section from August 4 to the end of the year. Ore and old tailings were treated by flotation at the Nottus mine. Gold ore from the Fort Ann mine was treated by amalgamation and concentration. Lessees worked the Grand Prize property near Pioneer from July 20 until the end of the year. Among the placer operations in the district were the Elephant mine worked by hydraulicking and the Bordeman property worked by dry-land dredging.

Ione district.—The Arroyo Seco Gold Dredging Co. operated two electric-powered connected-bucket dredges with a capacity of 6,000 and 2,000 cubic yards per 24 hours, respectively. The Buena Vista mine was worked under lease by the hydraulic method.

Mother Lode district.—The part of the Mother Lode district that passes through Amador County contains several of the largest and deepest gold mines of the State. The most important during 1936 were the Argonaut Mining Co., Ltd., Kennedy Mining & Milling Co., and the Central Eureka Mining Co. near Martell. The Argonaut Mining Co., Ltd., employed an average of 214 men throughout the year and in addition to its mine activities drove over 2,400 feet of development headings. The new 300-ton ball mill and flotation plant was tested during the summer and started continuous operations on August 27. Preparations were made for sinking to the 6,150-foot level during 1937; the mine was already the deepest in California.

The Kennedy mine derived the bulk of its tonnage during 1936 from its own old tailings pile but treated a considerable tonnage of ore from its mine. An average of 177 men was employed during the year. The Central Eureka Mining Co., worked the Old Eureka and Central Eureka mines. The Central Tailings Co. treated a large tonnage of old tailings from the Central Eureka dump by cyanidation. Another large tailings operation in the same area was that of the Delta Tailings Co., which cyanided a deposit of old tailings that had collected as a delta on one of the streams draining the Mother Lode district. The Amador Mother Lode Mining Co. started on August 10 with a crew of 30 men to rehabilitate the old Fremont and Gover mines near Drytown. An old stamp mill was repaired for testing the ore, and a 200-ton flotation plant was projected; there was no production during 1936. The Black Hills Mining Co. treated the ore from its mine in a five-stamp mill by amalgamation and concentration. A small quantity of very high-grade ore was reported from the Fuller mine. In addition to treating a large tonnage of ore in a 300-ton amalgamation and flotation plant, the Original Amador Gold Mines did over 3,200 feet of development work; an average of 80 men was employed throughout the year. Orr's custom mill treated ore derived from waste and prospect dumps; this 10-stamp mill equipped with amalgamation and concentration, was built during the year. Many

placer operations were reported in the district. Lessees operated a dry-land dredge at the Red Hill placer on the Vicini ranch for about 6 months.

BUTTE COUNTY

Forbestown district.—The Gold Bank, Golden Queen, and Midas developed by the Idaho Maryland Mines Corporation were the outstanding operations in the Forbestown district in 1936. Gold ore was treated by flotation and the concentrate trucked to the company concentrate cyanide plant at Grass Valley.

Magalia district.—Numerous miners worked both lode and placer properties in the Magalia district in 1936. A dry-land dredge at the Hintz mine on Butte Creek was one of the larger producers. Several mines, including the Bennett, Blue Channel, Blue Jay, Dally, Dix, and Emma, were in production.

Merrimac district.—Gold was produced at the Manzanita lode mine and the Last Chance placer claim during 1936.

Oroville district.—A dry-land dredge worked the Consuelo mine during 1936. The Butte Gold Dredging Co. operated a dragline dredge on the Bernhard ranch. Cinco Mineros Co. worked a dragline dredge the entire year. A dragline dredge operated by the Honcut Dredging Co. handled over 200,000 cubic yards of gravel on the Drescher property. The same company worked another dragline dredge on the Ford property. Dragline dredges were operated on Fortuna Acres and the Kehriotis property by the Butte Gold Dredging Co. The Penn Dredging Co. worked a dragline dredge from February to the end of the year on the Granella ranch. Some dragline work was done by the same company on the Ora M. Wheeler property. Richter & Sons operated a dragline dredge on Honcut Creek from March 25 to the end of the year. This company also did some dragline dredging on the Ross Lands Orchard Co. property. The Western Dredging Co. worked a dragline dredge in Wymans Ravine near Oroville from October 7 to the end of the year. By far the largest placer mine was that operated by the Yuba Consolidated Gold Fields Co., which worked an electric-power dredge of the connected-bucket type with a capaccity of 9,500 cubic yards per 24 hours throughout the year.

Palmero district.—The Wyandotte Gold Dredging Co., which operated a dragline dredge on the Farnham .ranch, was the leading producer in the Palmero district in 1936.

Yankee Hill district.—Hoeffling Bros. worked the Surcease mine throughout 1936 and treated a large quantity of gold ore in a 50-ton cyanide plant. Over 1,900 feet of development work were done, and an average of 39 men was employed. Several smaller operations, both lode and placer, were reported in the district.

CALAVERAS COUNTY

Camanche district.—The Atlas Gold Dredging Corporation operated a dragline dredge at the Gilhousen mine during 1936. A dredge of the connected-bucket type was operated throughout the year on Camanche Creek by the Camanche Placers, Ltd. The Comanche Gold Dredging Co. also operated a dredge of the connected-bucket type along the Mokelumne River, as did also the Lancha Plana Gold Dredging Co. A dry-land dredge of the Gold-Gravel Products, Inc., worked foothill placer ground near Wallace until May 24. The Wallace Dredging

Co. started operating its connected-bucket-type dredge on October 11 and continued operations until the end of the year.

Campo Seco district.—Drift mining at the Buffalo What Cheer and the Fourth of July properties were the most productive operations reported in the Campo Seco district in 1936.

Copperopolis district.—A number of lode and placer operations were reported in the Copperopolis district in 1936. Gold ore was mined at the Mountain King mine by the Jumbo Consolidated Mining Co. and a tailings dump was treated by the Gold Knoll Mining Co. at the Gold Knoll property.

East Belt district.—The Fine Gold Mining Co. worked the Fine Gold quartz mine throughout 1936 and treated the ore in a 40-ton ball mill by flotation. The Mar-John property was reported active the first part of the year. Old tailings were treated at the 100-ton cyanidation plant built during the year by the Union Consolidated Mining Co. at the Oro Plata mine near Murphy. A small quantity of ore from the Total Wreck property northeast of Angels Camp was treated in a 5-stamp mill. Numerous other lode and placer mines were reported active in the district.

Jenny Lind district.—The Royal mine was worked throughout 1936, and the ore was treated in a 20-stamp mill by amalgamation and flotation. A dragline dredge of the Milton Gold Dredging Co. worked gravel on Clear Creek and South Gulch.

Mother Lode district.—The section of the Mother Lode district that traverses Calaveras County has a number of productive gold mines located on it. By far the largest producer in 1936 was the Carson Hill operated by the Carson Hill Gold Mining Corporation. An average of 174 men was employed, and over 6,700 feet of development work were done. The ore was treated in a 1,000-ton amalgamation and cyanidation plant, which was enlarged during the year. The Lucky Joe Gold Mining Co. worked the Easy Bird mine. Gold ore was shipped for smelting from the Gopher Hill mine 9 miles from Milton by the Gopher Hill Mining Co. The Consolidated Mines of California treated the ore produced from the McKisson property 20 miles from Mokelumne Hill by amalgamation and flotation. The Morning Star mine, developed by open-pit method, was operated for a short time during the summer by the California Osborn Mining Co. The Mother Lode Central Mines, Inc., did 1,200 feet of development work at its property and had a small quantity of ore tested at the Russell mill near Angels Camp. The Delaray Mines developed the Gospel and Comet claims near San Andreas throughout the year and built a 100-ton amalgamation and concentration plant and other surface buildings; a small quantity of ore mined from an open-cut by power shovel was treated late in the year. The larger placer producers in the district were drift mines. The Calaveras Central Gold Mining Co. worked the Calaveras Central and produced a large quantity of gold. Another large producer was the Golden River Mining Co., which worked the Golden River property near Mokelumne Hill. The Tonopah Development Co., also a large producer of gold by drift mining, ceased operations at the Vallecito Western at the end of October, when the company lease terminated. A smaller drift operation was carried on at the Buck Bros. mine near San Andreas. A very small dredge of the connected-bucket type treated ore and hydraulic tailings in Chili Gulch. The dredge had

23 buckets of 1-cubic foot capacity each. The Flume House drift mine southwest of Mokelumne Hill employed an average of four men throughout the year.

ELDORADO COUNTY

East Belt district.—Ore from the Morey mine, which was operated throughout 1936, was treated in a 5-stamp amalgamation and concentration mill. The Cooley drift-placer mine was worked intermittently during 1936. A number of other lode and placer properties reported production.

Mother Lode district.—A very large number of lode and placer operations were reported in 1936 along that part of the Mother Lode that crosses Eldorado County. The Beebe-Alpine property was worked by the Beebe Gold Mining Co. throughout the year; the ore was treated in a 400-ton flotation and cyanidation mill. Another large lode producer was the Big Canyon mine worked by The Mountain Copper Co., Ltd.; the company employed an average of 128 men throughout the year and shipped to a smelter concentrate produced from ore treated in the 300-ton flotation mill. Over 2,700 feet of development work were driven and 3,800 feet of diamond drilling done. A substantial quantity of gold was recovered at the Black Oak mine near Garden Valley. The Briarcliffe Mines, Ltd., worked its mine until July and treated the ore produced in a 100-ton flotation mill; the concentrate was shipped for smelting. The Montezuma-Apex Mining Co. operated the Montezuma mine from the first of the year until July 13 and the Union Mine from March 1 until the close of the year. The ore from both mines was treated in the company 240-ton amalgamation and flotation mill. The Middle Fork Gold Mines Co. worked the Sliger mine and treated the ore in a 100-ton flotation mill. The Gold Co., Ltd., treated a large quantity of ore mined at the Veerkamp ranch near Garden Valley. In addition to the lode operations a large number of placer mines were worked in the Mother Lode district. The Pilot Hill Mining Co. operated a dry-land dredge on its Boulder claim (10 miles from Auburn). The Placeres De Oro Co. took over the Carpender drift mine on March 1 and operated from June 1 to the close of the year with 15 men employed. A dry-land dredge worked throughout the year near Lotus on the American River.

Rescue district.—The Gold Reserve mine was closed down during 1936 after a large tonnage of low-grade ore had been treated by cyanidation.

FRESNO COUNTY

Friant district.—There were several lode and placer operations in the Friant district in 1936. The Grant Service Rock Co., Consolidated, had the largest output of gold, which was obtained as a byproduct of its sand and gravel business.

HUMBOLDT COUNTY

Orleans district.—A large number of placer miners were active in the Orleans district during 1936. Two giants were in operation at the Pearch mine during the year.

IMPERIAL COUNTY

Cargo Muchacho district.—The Sovereign Development Co. treated the ore produced in 1936 at the Sovereign group near Ogilby at a 25-ton cyanide plant. Approximately 1,000 feet of development work was done during the year; an average of 17 men was employed. Riggs & Horgan leached old tailings at the Tumco mine in a 40-ton cyanide sand plant.

INYO COUNTY

Big Pine (Fish Springs) district.—In 1936 gold ore was treated by amalgamation at the Commetti mine by the Birch Creek Mining & Milling Co. Lessees on the Cleveland mine treated a small tonnage of ore at a custom cyanidation plant.

Carbonate district.—A small quantity of ore from the Coffin mine (37 miles from Shoshone) was treated by amalgamation in 1936.

Cerro Gordo district.—Gold ore was cyanided and lead ore shipped for smelting in 1936 from the Estelle-Cerro Gordo mine. The Keeler Gold Mines, Inc., treated gold ore by amalgamation from the Keeler mine during the early months of the year; the company prepared to handle custom ore as well. Lead ore was shipped for smelting from the Santa Rosa mine by the Santa Rosa Mines Development Co.

Chidago district.—The principal operation in the Chidago district in 1936 was the Cardinal Gold Mining Co., whose Cardinal mine was active throughout the year. The ore was treated in a 300-ton flotation plant and the concentrate shipped for smelting. The company distributed $100,000 in dividends to stockholders during the year.

Chloride Cliff district.—A number of miners were active in the Chloride Cliff district during 1936; most of the ore produced was shipped.

Modoc district.—The Orondo mine recovered a considerable quantity of gold by drift mining in 1936.

South Park district.—The American Eagle, Buster Brown, Margaret No. 2, Oro Grande, Radcliffe, and Stockwell were the principal producing mines in the South Park district in 1936.

Wild Rose district.—A number of miners were reported active in the Wild Rose district in 1936. The Silver Ball, Tuchi, Finance, and Napoleon mines were productive during the year.

KERN COUNTY

Agua Caliente district.—Lode and placer mining was reported active, and both ore and gold tailings were treated at mills in the Agua Caliente district in 1936.

China Grade district.—In 1936 the Kern Rock Co., Ltd., recovered a substantial quantity of gold as a byproduct from its sand and gravel plant.

Cove district.—The Kern Mines, Inc., worked the Big Blue mine throughout 1936 and treated a large tonnage of ore in its 100-ton flotation mill; an average of 36 men was employed, and 550 feet of development work were driven.

Havilah district.—The Bald Eagle and Drunkard's Dream produced small quantities of lode gold in 1936.

Mojave district.[3]—The discovery by Holmes on Soledad Mountain

[3] Julihn, C. E., and Horton, F. W., The Golden Queen and Other Mines of the Mojave District, California: Inf. Circ. 6931, Bureau of Mines, 1937, 42 pp.

in 1933 started more productive activity than any other strike in California in recent years. The ground where the discovery was made is now occupied by the Golden Queen Mining Co., the largest producer in the Mojave district and third largest silver producer in the State. This company employed an average of 145 men throughout 1936 and did over 9,800 feet of development. Ore was treated in the recently constructed 250-ton cyanide plant. The Lodestar Mining Co., a consolidation of a number of claims, including the Star Light, the Elephant, and Eagle groups, was the second largest producer on Soledad Mountain in 1936; the company employed an average of 39 men and did over 5,000 feet of development work. Most of the ore was treated by cyanidation, but some was shipped for smelting. The Soledad Extension mine of the Soledad Mojave Mining Syndicate was also an important producer in the district. This company shipped its ore to the cyanide plants operated by Burton Bros., Inc., which operated the Tropico mine and also one of the largest custom mills in the State. Both mine and custom ore was treated in a 100-ton cyanidation plant. A number of operators, including the Whitmore Mines, Inc., worked mines on Bowers Hill, and development with some production was reported from the Middle Buttes area.

Randsburg district.—The largest mine in the Randsburg district, the Yellow Aster, was operated throughout 1936 by the Anglo American Mines Corporation. This company treated a large tonnage of old tailings by cyanidation and a smaller tonnage of ore by amalgamation; an average of 78 men was employed throughout the year. The Butte Lode Mining Co. worked the Butte Lode mine during 1936 and did a small amount of custom-mill work in addition to amalgamating the ore it produced. The Buckboard mine was an important producer in the eastern part of the district. The Sunshine mine was operated during the last half of the year. In addition to the lode mines discussed, a number of other mines were in operation, most of them under lease. Placer operations were also reported in the district.

Woody district.—Several small operations, including dry-land dredging at the Horned Lark (Maltby) property, were reported in the Woody district in 1936.

LASSEN COUNTY

Hayden Hill district.—The Golden Eagle and the Juniper mines, operated by the Hayden Hill Gold Corporation, were the principal producers in the Hayden Hill district during 1936.

LOS ANGELES COUNTY

Cedar district.—The Governor Mining Co. operated the Governor mine and treated a considerable tonnage of gold ore by amalgamation in 1936. A number of smaller mines were also productive.

Neenach district.—The Suzanna and Valvue properties worked by Rogers and Gentry were the principal producing mines in the Neenach district in 1936. Over 900 feet of development work were done and a considerable quantity of gold ore was shipped for treatment at cyanide plants and smelters.

Saugus district.—The Marsam Gold Co. operated a dry-land dredge on the Conroy ranch property in Bouquet Canyon, leased from the

Soledad Placer Co., Ltd., in 1936. Early Californians discovered gold here over a 100 years ago.

San Gabriel district.—Small lode and placer operations were reported in the San Gabriel district in 1936.

Valyermo district.—A small shipment of bullion was made from the Big Horn mine late in 1936. The Allison Mining Co. worked its property (20 miles east of Azusa) throughout 1936 and treated its ore in a 25-ton ball mill by amalgamation and concentration.

MADERA COUNTY

Hildreth district.—Several lode mines in the Hildreth district, including the Red Bud, Buckeye, Keystone, Williams, and Parker, yielded small outputs of gold recovered by amalgamation in 1936.

Potter Ridge district.—Several small placer operations were reported in the Potter Ridge district in 1936. High-grade gravel was worked at the Bell mine by hand methods.

MARIPOSA COUNTY

Colorado district.—The Golden Empire Mining Co. worked the Schroeder group of mines and treated a considerable tonnage of gold ore by amalgamation in 1936; it was the largest producer in the Colorado district. Several smaller operations, including the Mocking Bird, Rex, Trabucco claims, and Twin Springs mines, were reported active.

Hite Cove district.—The Original and Ferguson mines were operated throughout 1936 by the San Juan Ramsey Co. of Boston. A large tonnage of ore was treated by amalgamation in a mill equipped with two concentrating tables. Most of the concentrate was cyanided, but a small tonnage was shipped for smelting. An average of 28 men was employed throughout the year, and over 2,300 feet of development work, including nearly 350 feet of shaft sinking, were done.

Hunter Valley district.—Old tailings at the Ruth Pierce mine (12 miles east of Merced Falls) were treated by a lessee in a 15-ton cyanide plant in 1936. Over 500 feet of development work were done and a small quantity of ore was treated at the San Gabriel mine. At the Orange Blossom property some production of gold by amalgamation was recorded, and over 250 feet of shaft-sinking and 400 feet of drifting were reported. In addition to the lode mines, Kumle and Ferris operated a dragline dredge from the middle of March until the end of the year; an average of 14 men was employed. The operators incorporated their business late in 1936 for operations in 1937 under the name of the Placer Properties Co., Inc.

Mother Lode district.—The southern end of the Mother Lode terminates in Mariposa County, and on it a number of small and medium-size mines were working during 1936. Gold ore was treated in a 5-stamp mill at the Ortega mine from April until the end of the year. Work at this property included the cleaning out of an old shaft from which Mexicans were said to have been evicted by General Fremont when he took possession of the Fremont grant in the early days. Development and some production at the Lovely Rogers mine east of Merced Falls were reported by Givens Bros. A shaft 100 feet deep was sunk at the Black Oak mine, and some ore was treated by amalgamation. The Hasloe mine was worked throughout the year, and the

ore recovered was amalgamated in a 5-stamp mill; a small tonnage of concentrate produced was not shipped. The Early Gold mine was worked intermittently, and a small output of gold was reported. In addition to the lode mines, a large number of placer miners worked the district during the year; the majority were snipers. Much of the placer gold recovered was sold through local gold buyers.

Whitlock district.—Development of Our Chance and Golden Key lode mines was reported in 1936 with an output from each being recorded. The Diltz mine was the largest producer in the district.

MERCED COUNTY

Snelling district.—Connected-bucket dredges in the Snelling district accounted for virtually all the gold produced in Merced County during 1936. The Snelling Gold Dredge Co. operated its 2 boats throughout the year and employed an average of 39 men. Each dredge had a daily capacity of 6,500 cubic yards and was electrically operated. The Yuba Consolidated Gold Fields also had two electrically operated dredges in the district, one with a capacity of 7,500 cubic yards and the other 4,500 cubic yards per 24-hour day. An average of 45 men was employed. The Merced Dredging Co. operated one electric-powered dredge with a capacity of 9,000 cubic yards per 24-hour day. In addition to these companies, the San Joaquin Mining Co. built a large connected-bucket-type dredge during the year for operations early in 1937.

MONO COUNTY

Bodie district.—The outstanding operation in Mono County during 1936 was that of the Roseklip Mines Co. at Roseklip mines, a group centering about the old Standard mine. This company built a 250-ton combination sand and slime cyanide plant and started milling on October 8. A considerable quantity of ore was treated by the end of the year. In addition, a number of lessees working on the same properties sent to the mill small quantities of old tailings and ore. The Blue Point mine was operated throughout the year and the ore produced was treated in a 15-ton stamp mill by amalgamation.

Chidago district.—A number of small operators reported the mining of gold ore in the Chidago district during 1936. The Gibson Oil Co. worked the Gold Crown mine in the Indian section. Other producers were the Gold Wedge, Beckman, Starter, Sierra Vista, New Deal, and Long Chance properties.

Topaz district.—A small quantity of lead ore was shipped to a smelter in 1936 from the Antimony property; over 200 feet of development work were done.

NEVADA COUNTY

French Corral district.—The Bradley Mining Co. worked the San Juan mine throughout 1936 and shipped gold ore for smelting. A number of small placer operations were also reported in the district. On Deer Creek a small connected-bucket dredge worked until November on the Dawson ranch (10 miles above Smartville). This dredge had 30 connected buckets, each of 1-cubic foot capacity, and was driven by gasoline power.

Grass Valley-Nevada City district.—The gold production of the Grass Valley-Nevada City district in 1936 continued to make it the leading metal-producing district of the State; in fact, this district was

among the largest in value of production in the United States. The Empire Star Mines Co., Ltd. (41.4 percent of its stock is owned by Newmont Mining Corporation), operated the Empire, Pennsylvania, North Star, Murchie, and Zeibright mines and was developing another mine named the Pennsylvania near Browns Valley, Yuba County. According to the company printed annual report, the Empire, North Star, and Pennsylvania mines at Grass Valley produced 244,473 tons with a metallurgical recovery of 95.39 percent or 0.368 fine ounce of gold per ton and an operating cost of $8.47. At the Murchie mine in the same district 102,401 tons of gold ore were milled with an average recovery of 0.217 ounce of gold and 0.745 ounce of silver; at the Zeibright mine east of Grass Valley 129,886 tons of ore were milled.

The Idaho Maryland Mines Corporation worked the Idaho Maryland and the Brunswick properties in the Grass Valley-Nevada City district and also carried on a large operation in the Forbestown district, Butte County, described elsewhere in this report. According to the company printed annual report, 293,975 tons of ore were produced at its Grass Valley operation, which had a gross recovery value of $3,308,450.45 or an average of $11.25 per ton. In addition, a large quantity of old tailings were treated by the company, and an extensive custom business in the reduction of ore and concentrates was carried on by the company's metallurgical works. During the year, 34,460 linear feet of development headings were driven and 13,458 feet of diamond drilling done. One of the most unusual developments in mining in California was the sinking of a circular shaft[4] with a 5-foot-diameter core drill, using chilled shot as the cutting medium. This shaft was sunk to a depth of 1,125 feet and placed in operation in July 1936.

The Lava Cap Gold Mining Corporation worked the Lava Cap, Banner, and Central properties and treated its ore in a 300-ton flotation concentration mill; the concentrates were shipped to a smelter. During the year 500 feet of shaft sinking and over 17,000 feet of other development work were done. An average of 229 men was employed throughout the year. At the Golden Center mine a large tonnage of ore was treated at an 80-ton stamp mill and a 125-ton flotation plant. The bulk of the gold and silver was recovered as bullion, but the gold concentrate saved by flotation yielded a considerable revenue when smelted. The company reported starting experimental work with scrapers in stopes. At the other company mine, the Kenny, two lessees produced a small quantity of gold ore. The Hoge mine of the Great Northern Gold Mines, Inc., was worked by lessees throughout the year; the ore produced was treated in a 75-ton flotation mill, and the concentrate was shipped for smelting. The Republic Gold Mining Corporation operated the Empress mine for the first 2½ months of the year and treated the ore produced in a 200-ton flotation plant. The Spring Hill Gold Mines, Inc., developed its property northeast of Grass Valley throughout the year and operated its 100-ton flotation plant from the first of the year until August 5. The company flotation concentrate was shipped to the Idaho Maryland custom cyanide plant. A number of small placer operations were reported in the district.

[4] Newsom, J. B., and Jackson, C. F., Shaft Sinking with a Shot Drill, Idaho Maryland Mine, Grass Valley, Calif.: Inf. Circ. 6923, Bureau of Mines, 1936, 10 pp.

Washington district.—The Bradley Mining Co. worked the Spanish mine (23 miles northeast of Nevada City) throughout 1936 and treated the bulk of its production in its 100-ton flotation and cyanidation plant; the concentrate and a small quantity of gold ore were shipped to a smelter. Although the principal product of the mine was gold, a considerable revenue was derived from the silver, lead, and copper content of the ore. Several other lode operations with smaller outputs were reported in the district. The Ancho Erie was closed down early in the year. In addition, a number of placer mines were worked during the year. The Shovel Placer Co. operated the Trude property on Spring Creek with a power shovel and stationary washing plant. The Davis Flat drift mine was one of the more productive placers. Western Gold, Inc., worked the Relief Hill mine by the hydraulic method and employed an average of 13 men during the first 6 months of the year. Two giants, each under a 250-foot head of water, were used.

PLACER COUNTY

Auburn district.—A dry-land dredge operated in 1936 at the Old Montezuma mine on the Hughes ranch southeast of Lincoln, and a number of other smaller placer operations were reported. The Burm-Ball Mining Co. at the Sisley ranch and the Rising Sun Mining Corporation, both lode properties, reported development work.

Butcher ranch district.—Development work proceeded during 1936 at the Sleepy Dutchman lode mine near McKeon, where it was hoped to develop a very large body of low-grade ore.

Colfax district.—Gold ore was treated by amalgamation and concentration at the Big Oak mine in the Colfax district in 1936. An average of 13 men was employed until the mine was closed down in September.

Dairy Farm district.—Operations at the Dairy Farm mine were suspended in 1936, and the machinery was sold.

Foresthill district.—A number of small operations, both lode and placer, were reported in the Foresthill district during 1936.

Gold Run district.—There were a number of large-scale placer operations in the Gold Run district in 1936. At the Fay placer mine a dragline dredge with a washing plant having a capacity of 800 cubic yards in 16 hours worked throughout the year. The Jasper-Stacey Co. worked the Recalp Co. property with a dragline dredge. Another large dragline operation was that of the Lincoln Gold Dredging Co., which employed an average of 12 men throughout the year and treated almost 450,000 cubic yards of bench gravel. The Oakwood Placer Mining Co. operated a dragline dredge with a capacity of 1,000 cubic yards every 24 hours and employed an average of 11 men throughout the year. On the Ruben Johnson ranch a dry-land dredge was operated from the middle of March until the end of the year.

Iowa Hill district.—There were a number of operations in the Iowa Hill district in 1936, including drift mining on the Truro property north of Iowa Hill, sluicing at the property of the Campbell Gold Mines, Inc., in the Wisconsin Hill section, and hydraulicking at the Lost Camp mine near Blue Canyon.

Last Chance district.—The Capitol Glenn Mining Co. worked a drift mine in the Last Chance district for a short time in 1936. The Echoless lode mine was active the early part of the year.

Loomis district.—The Gold Hill Dredging Co. operated its dredge, of the connected-bucket type, throughout 1936 and treated over 840,000 cubic yards of river gravel. The Antelope Creek Dredging Co. worked its Antelope Creek property with a dredge of the same type. The Lincoln Gold Dredging Co. started work with its dry-land dredge in September; another dry-land washing plant using a dragline excavator worked the Miners Ravine property during the early months of the year. Drift mining was reported at the SERA and Yellow Jacket mines.

Michigan Bluff district.—Drift mining was reported at the Burn's Channel mine northeast of Michigan Bluff in 1936; testing work was carried on throughout the year.

Ophir district.—The Auburn-Pacific mine was worked by the South Star Gold Mines Co. until May 1, 1936, when it was taken over by the Auburn Pacific Mines, Inc. The latter company installed a headframe, hoist, pumps, blacksmith shop, and other equipment and produced a small quantity of gold from test runs made before the end of the year. Smaller outputs were reported at the TWA, St. Lawrence, and Two Orphans mines.

PLUMAS COUNTY

Butte Valley district.—Sluicing was carried on in 1936 at the Yankee Bar-Riverside-Marion Creek and Feather River No. 1 properties and drift mining at the Phillips Bench, Boomerang, and Glacier mines.

Crescent Mills district.—The Indian Valley Mining Co., Inc., worked the Standart mine near Greenville in 1936 and treated its ore in a 10-stamp mill. The Gold Stripe mine was worked by the Almanor Gold Mining Co. throughout the year; the ore was treated in a 50-ton amalgamation and flotation mill. A number of small placer producers were active.

Genesee district.—The Walker Mining Co., an affiliate of the Anaconda Copper Mining Co., operated the Walker mine throughout 1936 and was the principal mineral producer in Plumas County; the mine is the largest copper mine in the State and is equipped with a 1,600-ton flotation plant. According to the company's printed annual report 468,453 tons of ore were broken during the year and 453,794 tons milled, from which 21,998 tons of concentrate was produced; the total metal paid for was 9,614,277 pounds of copper, 268,141 ounces of silver, and 11,666.57 ounces of gold. The company did almost 14,000 feet of development work during the year. A small output of gold ore from the Gold Leaf mine was reported.

Lights Canyon district.—The Bill Lode mine and the Lucky S placer mine were the leading producers in 1936 in the Lights Canyon district.

Quincy district.—A number of placers were operated in the Quincy district in 1936. A dry-land dredge operated the Brilliant placer property near Twain during the summer months.

Virgilia district.—The Virgilia Mining Corporation milled a large tonnage of ore in its 125-ton flotation plant in 1936. This mill was built during the year and started operations late in August. The concentrate was shipped for smelting and was valued chiefly for its gold content.

153336—37——20

RIVERSIDE COUNTY

Chuckawalla district.—Mining was reported at the Golden Key and Red Cloud properties during 1936.

Dale district.—The Gold Crown Mining Co., Ltd., worked the Gold Crown and Nightingale claims throughout 1936 and treated its gold ore in a 50-ton all-slime cyanide plant. One thousand feet of development work were done, including 100 feet of shaft sinking. The Mission Gold Mining Co. worked continuously developing the Huff-Lane property (50 miles northeast of Mecca) and treated a small quantity of gold ore by amalgamation in an arrastre. Development work and mining were reported at the Golden Rod and Star mines.

Pinacate district.—There was considerable activity in the Pinacate district during 1936, and several small yields of gold were reported. A small tonnage of gold ore from the Hoag mine was treated in a 10-ton 2-stamp mill.

Pinon district.—In 1936 old tailings were worked by cyanidation at the Lost Horse mine near Twentynine Palms, and a small tonnage of gold ore from the Blue Bell property was milled.

SACRAMENTO COUNTY

Consumnes district.—The Consumnes Gold Dredging Co. operated a connected-bucket-type dredge with capacity of 10,000 cubic yards per 24 hours the last quarter of 1936.

Folsom district.—The Folsom district was the most productive placer area in the State in 1936. The Natomas Co. operated 6 dredges of the connected-bucket type and employed an average of 280 men throughout the year. Two of the dredges ceased operations in April 1936, but the company had two dredges under construction at the end of the year. The Capital Dredging Co. operated 3 dredges in the district, all of which were powered by electricity; this company employed an average of 91 men throughout the year. Gold Hill Dredging Co. had one dredge working in the Folsom district and handled almost 2,000,000 cubic yards of gravel during the year. A dredge with a 5,000 cubic-yard-per-day capacity was operated by the Sacramento Gold Dredging Co. throughout the year. A dry-land dredge at Mississippi Bar was worked for a part of the year by the Camp Exploration Co., Inc.

SAN BERNARDINO COUNTY

Calico district.—Cyanidation of old tailings in the Calico district in 1936 yielded most of the gold and silver outputs. Ore from the Comanche and Sioux claims was cyanided; silver was the predominating metal in the ore.

Holcomb Valley district.—A small dry-land dredge worked the Marple claim at the head of Van Duzen Canyon the latter part of 1936. Small placer operations in the district yielded approximately 250 ounces of gold.

Ivanpah district.—A small shipment oı silver ore from the Stonewall Jackson mine was sent to a smelter in 1936, and 200 feet of development work were done.

Old Woman Mountains district.—Production was reported in 1936 from the Gemco (Mable group) and Goldfield No. 1 mines.

Randsburg district.—Although the larger part of the Randsburg district lies in Kern County, an important section extends into San Bernardino County. Silver ore was shipped to a smelter in 1936 from the Santa Fe group, and over 2,500 feet of development work were done. The Coyote mine was operated during the first 3 months of the year, and gold-silver ore was shipped for smelting. In the Atolia section of the district the Atolia Rand Placers, Inc., operated a gravel-washing and concentration plant and recovered a considerable quantity of gold as well as tungsten materials.

Silver Mountain district.—Gold-silver ore was treated in a 20-ton concentration plant at the Carbonate mine during the later months of 1936, and a lead concentrate was shipped to a smelter.

SHASTA COUNTY

Clear Creek district.—The Golden State Dredging Co. operated a dragline on Olney Creek from June 4 until the end of 1936. Another dragline dredge was working in China Gulch near Redding from August 7 until the end of the year. The Lone Hill mine was worked with a stationary washing plant supplied with gravel by a gas shovel and truck. In addition, a large number of small placer miners worked the creek gravel.

Cottonwood Creek district.—The Midland Co. operated a floating washing plant and dragline shovel, both equipped with Diesel power throughout 1936.

French Gulch district.—Several lode and placer operators were active in the French Gulch district during 1936.

Igo district.—The Pioneer Dredging Co. operated two dragline dredges in the Igo district throughout 1936. On December 29, a third boat was put into operation.

Iron Mountain district.—The Mountain Copper Co., Ltd., worked the Iron Mountain property and was the largest producer of gold and silver in Shasta County in 1936; the ore was treated in a 600-ton cyanide leaching plant; an average of 84 men was employed throughout the year.

Shasta district.—The Dowling Mining & Investment Co. worked the Walker mine throughout 1936 and built a 100-ton all-slime countercurrent decantation cyanide plant, which was put into operation on August 17. A dry-land dredge treated 100,000 cubic yards of stream gravel at the Clear Creek Placers 5 miles from Shasta.

SIERRA COUNTY

Alleghany district.—The Original Sixteen to One Mine, Inc., worked the Original Sixteen to One and the Tightner mines continuously in 1936 and treated a large tonnage of gold ore in a 100-ton amalgamation and concentration plant; an average of 77 men was employed, and over 1 mile of development headings was driven. The Kenton mine north of Nevada City was worked throughout the year, and the gold ore produced was treated in the 30-ton, 10-stamp amalgamation mill there. Over 1,000 feet of development work, including the sinking of 350 feet of inclined shaft, were done during the year. Gold ore from the Ruby mine was treated in a 30-ton stamp mill with amalgamation followed by tabling and flotation. Over 7,000 feet of development were done during the year. The Oriental Mining Co. worked the Oriental mine during the last 6 months of the year and

treated the ore produced in a 10-stamp mill. Socorro Mines, Inc., worked the Plumbago mine all year. Over 1,100 feet of development work were done, and the ore produced was treated in a 10-stamp mill. In addition to the lode mining, a large number of small placer properties were worked.

Downieville district.—Virtually all the gold produced from the Downieville district in 1936 was derived from placer mines.

Gold Lake district.—A dry-land dredge worked for a few months in 1936 on the Golden Meadow mine patented claims.

Pike district.—The Scales Placer Mining Co. worked the Scales property (12 miles northeast of Strawberry Valley) by the hydraulic method in 1936.

SISKIYOU COUNTY

Klamath River district.—A number of small mine operators as well as snipers were active in the Klamath River district during 1936. The Kah Sek Co. operated a dragline dredge on the Tony Lund Bar from April 1. The Reeve mine near Happy Camp was worked by hydraulicking during the year. The Lowden mine was also worked by hydraulicking.

North Central district.—Gold ore was treated in a 12-ton, 5-stamp mill at the Mount Vernon property, which was worked continuously during 1936. The Cal Oro Dredging Co. operated a dredge with a capacity of 3,000 cubic yards per 24 hours on Greenhorn Creek. A substantial quantity of gold was recovered from the Big Boulder and Big Oak drift mine near Hawkinsville.

Salmon River district.—In 1936 the King Solomon Mines Co. treated a large tonnage of ore from the King Solomon mine in the Liberty section in its 300-ton amalgamation mill; a very extensive exploration campaign of trenching with tractors and bulldozers was carried on during the first 3 months of the year; approximately 10½ miles of trenches were opened. In addition, over 3,000 feet of underground headings were driven. A very large number of placer operations, most of them small, were reported. Gravel was hydraulicked at the Banner, S. T. S., Tea Bar, Dig More, Joubert, Summerville, and a number of other properties.

Scott River district.—There were many operations, both lode and placer, in the Scott River district in 1936. Among these, the Northern California Goldfields, Inc., worked the Morrison-Carlock mines and treated the ore produced in a 10-stamp mill. Ore was mined and amalgamated at the Fairview No. 1, Gold Reef, Mountain View, and Star mines; 30 men were employed.

TRINITY COUNTY

Big Bar district.—A number of small placer operations were reported in the Big Bar district in 1936. The M. R. K. Mining Co. worked the Osborn Hill mine by the hydraulic method until the end of April, when the lease was surrendered.

Hayfork district.—In 1936 the Hayfork Gold Dredging Co. operated a dragline dredge from September 22 to the end of the year. The plant used diesel power and had a capacity of 3,000 cubic yards per 24 hours; an average of 19 men was employed. Gold ore was produced at the Ballyhoo mine, where development work was carried on actively.

Helena district.—The Chiksan Oil Co., Ltd., worked the Enterprise mine 50 miles west of Redding throughout 1936 and operated its 10-stamp mill for 8 months. An average of 18 men was employed at the property.

Junction City district.—The Junction City Mining Co. operated an electric-powered dredge of the connected-bucket type, with a capacity of 7,000 cubic yards per 24 hours throughout 1936. The Red Hill mine of the Northern California Mines Co. was worked by independent miners under operating agreements. Lode mining was also reported in the district.

Lewiston district.—In 1936 the Trinity Dredging Co. worked continuously a dredge of the connected-bucket type, with a daily capacity of 3,000 cubic yards. The Brown Bear mine, operated by the Brown Bear Mining Co., was the largest producer of lode gold in the county during 1936. A number of small mines, both lode and placer, also were productive.

New River district.—A large number of lode and placer operations accounted for the gold output of the New River district in 1936.

Salyer district.—In 1936 the Swanson Mining Corporation hydraulicked a small quantity of bench gravel on the South Fork of the Trinity River.

Weaverville district.—The Redding Creek Placer, Inc., was the largest producer of placer gold in the Weaverville district in 1936; hydraulic operations were carried on until June 8.

TUOLUMNE COUNTY

Columbia district.—Pocket hunters continued to search the hills of this district during 1936, and a number of very rich discoveries were made. In addition to the pocket hunters, a number of miners worked placer deposits. The Springfield drift placer was operated by the Springfield Land Co. and produced a considerable quantity of gold. Sizable outputs were reported from the Experimental and Little Bonanza lode mines.

East Belt district.—The Columbus Gold Mining Co. worked an average of 45 men at the Columbus mine near Tuolumne throughout 1936 and treated gold ore by amalgamation and flotation in a 30-ton stamp mill; 3,956 feet of development work were done. A 15-ton concentration mill treated the ore mined at the Jigger Bill's Brother mine also near Tuolumne. Development work was carried on at the Telegraph mine east of Chinese Camp and a 5-ton stamp mill was built. The Soulsby-Belle mine was operated by the Soulsby-Belle Mining Co. the full year. A number of placer operations were reported in the district, the largest of which was a dry-land dredge operated near Chinese Camp by the Menke-Hess Gravels, Inc.

Mother Lode district.—The Hitchcock mine was worked throughout 1936 and the ore produced treated in a 50-ton amalgamation and concentration mill. The Oak Mesa mine (8 miles northeast of Merced Falls) was under development during 1936 and produced a small quantity of ore that was treated in a 30-ton stamp mill. Experimental milling was carried on at the Eagle Shawmut mine preparatory to reopening in 1937.

YUBA COUNTY

Browns Valley district.—Ore was treated by amalgamation in 1936 at the Sweet Vengeance property near Browns Valley. The Empire Star Mines Co., Ltd., continued an extensive exploration campaign at its Pennsylvania mine 25 miles west of its Grass Valley mines.

Smartville district.—The Gold Exploration Mining Co. worked the Blue Point gravel mine by drift mining in 1936; an average of 30 men was employed throughout the year, and its production made the company one of the important drift operators in the State. On the Yuba River near Smartville was one of the largest camps of gold "snipers" in California; even at low water probably 100 miners were working the river gravels at various times.

Strawberry Valley district.—A number of small placer operations using hand methods were reported in the Strawberry Valley district in 1936.

Yuba River district.—By far the largest operation in 1936 in Yuba County was that of the Yuba Consolidated Gold Fields, which had a fleet of five large gold dredges of the connected-bucket type working throughout the year in the Yuba River district.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN COLORADO

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

The total output of gold, silver, copper, lead, and zinc from Colorado ore and gravels in 1936, in terms of recovered and estimated recoverable metals, was 366,607.00 fine ounces of gold, 5,902,776 fine ounces of silver, 17,730,000 pounds of copper, 14,534,000 pounds of lead, and 2,344,000 pounds of zinc. This output compares with a production in 1935 of 349,280.80 ounces of gold, 4,696,064 ounces of silver, 14,654,000 pounds of copper, 11,345,000 pounds of lead, and 2,403,000 pounds of zinc. There were 714 lode mines and 601 placers producing in 1936, a decrease of 156 lode mines and 241 placers from 1935. The smaller number of lode mines in 1936 than in 1935 is due to a decrease in the number of mines, prospects, and dumps producing less than 25 tons of ore, each of which is counted in this report as a producing mine if the material sold yielded any recovered metal. The decrease in the number of placers is explained by the fact that fewer individuals were engaged in sluicing and panning than in 1935; also one floating dredge that was operated in 1935 was idle in 1936.

The total recorded output from Colorado ores and gravels from 1858 to 1936, inclusive, all in terms of recovered metals, has been, according to Chas. W. Henderson, 36,446,165 ounces of gold, 678,248,882 ounces of silver, 374,148,430 pounds of copper, 4,650,756,583 pounds of lead, and 2,239,203,985 pounds of zinc.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the prices given in the

table that follows. Gold in 1932 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1837, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95 per ounce, the yearly average weighted United States Government price[1]; and in 1935 and 1936 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1932 and 1933 is the average New York price for bar silver; in 1934, the Treasury buying price ($0.64646464+ per ounce) for newly mined silver; and in 1935 and 1936, the yearly average weighted Treasury buying price for newly mined silver. The copper, lead, and zinc prices are weighted yearly averages of all grades of primary metal sold by producers.

Prices of gold, silver, copper, lead, and zinc, 1932–36

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[1] $20.67+	$0.282	$0.063	$0.030	$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050

[1] $20.671835. [2] $0.64646464.

Mine production of gold, silver, copper, lead, and zinc in Colorado, 1932–36, in terms of recovered metals

Year	Mines producing			Ore sold or treated (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Total		Fine ounces	Value	Fine ounces	Value
1932	478	335	813	935,895	317,927.95	$6,572,154	1,860,408	$524,635
1933	614	286	900	845,495	242,827.70	6,206,676	2,186,140	765,149
1934	929	967	1,896	1,309,187	324,923.32	11,356,070	3,475,661	2,246,892
1935	870	842	1,712	1,770,984	349,280.80	12,224,828	4,696,064	3,375,296
1936	714	601	1,315	2,151,849	366,607.00	12,831,245	5,902,776	4,571,700

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1932	7,398,000	$466,074	4,299,000	$128,970	218,000	$6,540	$7,698,373
1933	9,667,000	618,688	4,803,000	177,711	2,569,000	107,898	7,876,122
1934	11,294,000	903,520	8,435,000	312,095	1,544,000	66,392	14,884,969
1935	14,654,000	1,216,282	11,345,000	453,800	2,403,000	105,732	17,375,938
1936	17,730,000	1,631,160	14,534,000	668,564	2,344,000	117,200	19,819,869

[1] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Gold and silver produced at placer mines in Colorado, 1932–36, in fine ounces, in terms of recovered metals

Year	Sluicing and hydraulic		Drift mining		Dry-land dredges [1]		Floating dredges		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1932	[2] [3] 1,376.79	[2] [3] 283	(3)	(3)	(2)	(2)	1,122.02	288	2,498.81	571
1933	[3] 2,046.85	[3] 480	(3)	(3)	464.70	69	2,813.96	711	5,325.51	1,260
1934	[3] 4,086.39	[3] 855	(3)	(3)	3,594.34	533	7,292.26	1,828	14,972.99	3,216
1935	[3] 7,058.74	[3] 1,523	(3)	(3)	7,998.55	1,329	4,305.71	1,116	19,363.00	3,968
1936	2,307.74	573	1,990.14	403	7,754.79	1,365	1,528.33	364	13,581.00	2,705

1 Dragline and power-shovel excavators with sluices or special amalgamators.
2 Figures for sluicing and hydraulic include those for dry-land dredges.
3 Figures for sluicing and hydraulic include those for drift mining.

Gold.—The production of gold in Colorado in 1936, in terms of recovered metal, was 366,607.00 fine ounces valued at $12,831,245, an increase of 17,326.20 ounces in quantity and $606,417 in value over 1935. In 1936 the Cripple Creek district contributed 141,608.20 ounces (38.63 percent of the State total). Park County yielded 56,267.20 ounces (15.35 percent); Boulder, 25,963.20 ounces (7.08 percent); Clear Creek, 24,441.60 ounces (6.67 percent); Gilpin, 22,569.80 ounces (6.16 percent); San Juan, 22,162.00 ounces (6.05 percent); Lake, 15,284.80 ounces (4.17 percent); Rio Grande, 12,989.14 ounces (3.54 percent); San Miguel, 12,231.60 ounces (3.34 percent); Eagle, 11,947.00 ounces (3.26 percent); and Ouray, 8,979.20 ounces (2.45 percent). The largest increases were 17,284.20 ounces in Teller County, 8,070.60 ounces in Clear Creek, 6,034.00 ounces in San Juan, and 4,870.14 ounces in Rio Grande; the largest decreases were 15,675.66 ounces in Park County and 4,516.94 ounces in Jefferson. Dry and siliceous ores yielded 91.52 percent of the total gold, copper and copper-lead ores 2.89 percent, lead and lead-zinc ores 1.89 percent, and placers 3.70 percent.

Silver.—The production of silver in Colorado in 1936, in terms of recovered metal, was 5,902,776 fine ounces valued at $4,571,700, an increase of 1,206,712 ounces in quantity and $1,196,404 in value over 1935 compared with an increase of 1,220,403 ounces in quantity and $1,128,404 in value in 1935 over 1934. In 1936 Eagle County produced 3,697,632 ounces (62.64 percent of the State total); San Juan, 432,603 ounces (7.33 percent); Mineral, 422,071 ounces (7.15 percent); Ouray, 406,244 ounces (6.88 percent); and Pitkin, 198,319 ounces (3.36 percent). The largest increases were 905,362 ounces in Eagle County, 180,061 ounces in Ouray, and 150,185 ounces in San Juan; the only important decreases were 77,609 ounces in Mineral County and 51,009 ounces in Dolores. Dry and siliceous ores yielded 32.98 percent of the total silver, copper and copper-lead ores 62.84 percent, lead and lead-zinc ores 4.14 percent, and placers 0.04 percent.

Copper.—The production of recoverable copper in Colorado in 1936 was 17,730,000 pounds valued at $1,631,160, an increase of 3,076,000 pounds in quantity and $414,878 in value over 1935. Eagle County produced 15,932,700 pounds (90 percent of the State total); next in order were San Juan (991,400 pounds), Ouray (250,500 pounds), and Clear Creek (187,400 pounds). The largest increases were 2,749,700 pounds in Eagle County, 367,400 pounds in San Juan, and 57,400 pounds in Clear Creek; the largest decrease was 67,000

pounds in Park County. Copper ore yielded 90 percent of the total copper, dry and siliceous ores 9 percent, and other types of ore 1 percent.

Lead.—The production of recoverable lead in Colorado in 1936, reckoned as lead in lead bullion and in leaded zinc oxide, was 14,534,000 pounds valued at $668,564, an increase of 3,189,000 pounds in quantity and $214,764 in value over 1935. In 1936 Lake, Ouray, Park, San Juan, and San Miguel Counties each produced more than 1,000,000 pounds. The other important producing counties were Eagle, 982,800 pounds; Pitkin, 669,000 pounds; and Clear Creek, 578,300 pounds. Dry and siliceous ores yielded 54 percent of the total lead; lead ore, 31 percent; copper and copper-lead ores, 9 percent; and lead-zinc ore, 6 percent.

Zinc.—The zinc-bearing ores and concentrates marketed from Colorado in 1936 contained 2,344,000 pounds of recoverable zinc valued at $117,200, a decrease of 59,000 pounds in quantity from 1935, but an increase of $11,468 in value due to the higher average price in 1936. Lead-zinc sulphide ore shipped from Lake County to the pigment plant at Coffeyville, Kans., and zinc-lead ore containing gold, silver, and copper shipped from Dolores, Gunnison, Lake, and Summit Counties to reduction plants in Utah contained most of the zinc recovered from ore mined in Colorado in 1936; the remainder was produced from zinc concentrates (a byproduct of dry silver ore from Pitkin County and dry gold ore from Gilpin County) shipped to Amarillo, Tex.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1936, by counties, in terms of recovered metals

County	Mines producing			Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Total	Fine ounces	Value	Fine ounces	Value
Adams		13	13	85.20	$2,982	13	$10
Arapahoe		6	6	38.00	1,330		
Boulder	173	11	184	25,963.20	908,712	59,082	45,759
Chaffee	19	20	39	1,686.20	59,017	13,778	10,671
Clear Creek	91	51	142	24,441.60	855,456	111,885	86,655
Costilla		3	3	13.20	462	1	1
Custer	10		10	92.00	3,220	5,898	4,568
Dolores	3		3	308.60	10,801	20,031	15,514
Douglas		10	10	24.40	854		
Eagle	15	1	16	11,947.00	418,145	3,697,632	2,863,816
Fremont		1	1	2.80	98		
Gilpin	76	108	184	22,569.80	789,943	77,947	60,370
Grand		5	5	4.60	161		
Gunnison	9	15	24	2,903.60	101,626	5,765	4,465
Hinsdale	1		1	90.60	3,171	62	48
Jefferson		34	34	106.20	3,717	22	17
Lake	55	11	66	15,284.80	534,968	134,062	103,831
La Plata	12		12	1,204.60	42,161	11,051	8,559
Larimer	2		2	74.00	2,590	88	68
Mesa	1	9	10	4.00	140	14	11
Mineral	8		8			422,071	326,894
Moffat		13	13	218.80	7,658	13	10
Montezuma	3		3	1,593.20	55,762	3,414	2,644
Montrose		45	45	161.20	5,642	44	34
Ouray	7	2	9	8,979.20	314,272	406,244	314,636
Park	24	136	160	56,267.20	1,969,352	50,302	38,959
Pitkin	3		3	4.60	161	198,319	153,598
Rio Grande	1		1	12,989.14	454,620	25,271	19,572
Routt	1	11	12	30.06	1,052	453	351
Saguache	7		7	315.26	11,034	16,330	12,648
San Juan	25	1	26	22,162.00	775,670	432,603	335,051
San Miguel	23	16	39	12,231.60	428,106	167,211	129,505
Summit	23	66	89	3,202.14	112,075	26,625	20,621
Teller	122	13	135	141,608.20	4,956,287	16,545	12,814
	714	601	1,315	366,607.00	12,831,245	5,902,776	4,571,700
Total, 1935	870	842	1,712	349,280.80	12,224,828	4,696,064	3,375,296

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1936, by counties, in terms of recoverable metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Adams							$2,992
Arapahoe							1,330
Boulder	32,000	$2,944	135,000	$6,210			963,625
Chaffee	18,000	1,656	234,000	10,764			82,108
Clear Creek	187,400	17,241	578,300	26,602			985,954
Costilla							463
Custer	2,300	212	44,000	2,024			10,024
Dolores	14,000	1,288	238,000	10,948	279,000	$13,950	52,501
Douglas							854
Eagle	15,932,700	1,465,808	982,800	45,209			4,792,978
Fremont							98
Gilpin	32,000	2,944	328,700	15,120	12,000	600	868,977
Grand							161
Gunnison			26,000	1,196	5,000	250	107,537
Hinsdale			400	18			3,237
Jefferson							3,734
Lake	43,000	3,956	3,107,000	142,922	1,742,000	87,100	872,777
La Plata			13,300	612			51,332
Larimer							2,658
Mesa	1,000	92					243
Mineral			370,800	17,057			343,951
Moffat							7,668
Montezuma	2,000	184					58,590
Montrose							5,676
Ouray	250,500	23,046	1,410,000	64,860			716,814
Park	25,000	2,300	1,634,000	75,164			2,085,775
Pitkin			669,000	30,774	200,000	10,000	194,533
Rio Grande	70,000	6,440					480,632
Routt	200	18	3,600	166			1,587
Saguache	65,000	5,980	278,700	12,820			42,482
San Juan	991,400	91,209	3,112,900	143,193			1,345,123
San Miguel	51,000	4,692	1,134,000	52,164			614,467
Summit	12,500	1,150	233,500	10,741	106,000	5,300	149,887
Teller							4,969,101
	17,730,000	1,631,160	14,534,000	668,564	2,344,000	117,200	19,819,869
Total, 1935	14,654,000	1,216,282	11,345,000	453,800	2,403,000	105,732	17,375,938

Gold and silver produced at lode mines in Colorado in 1936, by counties, in terms of recovered metals

County	Ore sold or treated	Gold	Silver
	Short tons	*Fine ounces*	*Fine ounces*
Boulder	106,233	25,589.40	59,051
Chaffee	1,528	1,578.20	13,765
Clear Creek	135,575	24,360.20	111,876
Custer	662	92.00	5,898
Dolores	808	308.60	20,031
Eagle	254,968	11,945.40	3,697,632
Gilpin	352,444	17,820.20	77,029
Gunnison	10,802	2,867.80	5,756
Hinsdale	29	90.60	62
Lake	118,121	13,690.60	133,805
La Plata	13,115	1,204.60	11,051
Larimer	59	74.00	88
Mesa	14		14
Mineral	10,738		422,071
Montezuma	216	1,593.20	3,414
Ouray	41,511	8,951.80	406,164
Park	120,425	52,933.20	49,681
Pitkin	26,700	4.60	198,319
Rio Grande	49,459	12,989.14	25,271
Routt	9	2.06	444
Saguache	4,591	315.26	16,330
San Juan	204,281	22,160.00	432,603
San Miguel	89,810	12,166.80	167,184
Summit	2,061	749.34	25,991
Teller	607,690	141,539.00	16,541
	2,151,849	353,026.00	5,900,071
Total, 1935	1,770,984	329,917.80	4,692,096

Gold and silver produced at placer mines in Colorado in 1936, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Drift mining		Dry-land dredges [1]		Floating dredges		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Adams	85.20	13							85.20	13
Arapahoe	38.00								38.00	
Boulder	123.44	10			250.36	21			373.80	31
Chaffee	108.00	13							108.00	13
Clear Creek	72.74	8			8.66	1			81.40	9
Costilla	13.20	1							13.20	1
Douglas	24.40								24.40	
Eagle	1.60								1.60	
Fremont	2.80								2.80	
Gilpin	270.15	150			4,479.45	768			4,749.60	918
Grand	4.60								4.60	
Gunnison	35.80	9							35.80	9
Jefferson	106.20	22							106.20	22
Lake	40.14	5			1,554.06	252			1,594.20	257
Mesa	4.00								4.00	
Moffat	36.07	2	2.04		180.69	11			218.80	13
Montrose	115.85	34			45.35	10			161.20	44
Ouray	1.38	1			26.02	79			27.40	80
Park	525.11	96	1,984.60	402	824.29	123			3,334.00	621
Routt	28.00	9							28.00	9
San Juan	2.00								2.00	
San Miguel	64.80	27							64.80	27
Summit	535.06	169	3.50	1	385.91	100	1,528.33	364	2,452.80	634
Teller	69.20	4							69.20	4
	2,307.74	573	1,990.14	403	7,754.79	1,365	1,528.33	364	13,581.00	2,705
Total, 1935	[2] 7,058.74	[2] 1,523	(2)	(2)	7,998.55	1,329	4,305.71	1,116	19,363.00	3,968

[1] Dragline and power-shovel excavators with sluices or special amalgamators.
[2] Figures for sluicing and hydraulic include those for drift mining.

MINING INDUSTRY

The bulk of the ore produced in Colorado, 1933–36, was dry and siliceous gold, gold-silver, and silver ores and copper ore valuable chiefly for its gold and silver content. The output of these ores totaled 2,115,175 tons, or 98.3 percent, of the State total for all classes of ore in 1936; 1,744,691 tons, or 98.5 percent, in 1935; 1,299,469 tons, or 99.3 percent, in 1934; and 832,873 tons, or 98.5 percent, in 1933. The increase of 151 percent in output of dry and siliceous ore in 1936 over 1933 resulted principally from large expenditures of capital for consolidating, developing, and equipping old gold- and silver-producing properties. Large-scale mining and milling of lead and lead-zinc ores, suspended in 1930–31, had not been resumed to May 20, 1937. In 1929 combined lead and lead-zinc ores constituted 42 percent of the State total for all classes of ore. The quantity of gravel handled in 1936 at placer mines by 1 floating bucket-type dredge and 23 land-dredge installations was approximately 943,478 yards; specific data on yardage handled at small-scale placer operations are not obtainable because of lack of knowledge by the operator of the quantity of gravel sluiced.

To continue annual detailed statistics for Colorado on mine production by classes of ore, methods of recovery of metals, and mining districts, the data for 1935 not available for inclusion in Minerals Yearbook, 1936, are supplied in this chapter.

ORE CLASSIFICATION

Ore sold or treated in Colorado, 1935–36, with content in terms of recovered metals

Source	Ore	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	1,308,308	297,290.83	531,139	705,508	4,109,337	
Dry and siliceous gold and silver ore	184,782	17,068.36	282,020	613,444	1,450,525	
Dry and siliceous silver ore	42,444	151.03	860,363	18,650	1,311,069	250,000
	1,535,534	314,510.22	1,673,522	1,337,602	6,870,931	250,000
Copper ore	209,492	8,529.28	2,789,222	13,216,180	311,900	
Copper-lead ore	295	89.70	6,550	23,750	79,200	
Lead ore	16,419	5,960.83	154,468	52,202	3,147,503	
Lead-zinc ore	9,244	827.77	68,334	24,266	935,466	2,153,000
	235,450	15,407.58	3,018,574	13,316,398	4,474,069	2,153,000
Total, lode mines	1,770,984	329,917.80	4,692,096	14,654,000	11,345,000	2,403,000
Total, placers		19,363.00	3,968			
	1,770,984	349,280.80	4,696,064	14,654,000	11,345,000	2,403,000
1936						
Dry and siliceous gold ore	1,569,171	312,106.53	509,673	627,515	4,003,410	12,000
Dry and siliceous gold and silver ore	225,294	22,875.60	379,348	947,012	1,330,065	
Dry and siliceous silver ore	66,966	549.50	1,057,485	57,159	2,453,616	200,000
	1,861,431	335,531.63	1,946,506	1,631,686	7,787,091	212,000
Copper ore	253,871	10,569.34	3,693,303	15,930,055	987,107	
Copper-lead ore	910	15.86	15,740	65,540	271,500	
Lead ore	25,724	6,124.15	220,644	79,789	4,550,460	
Lead-zinc ore	9,913	785.02	23,878	22,930	937,842	2,132,000
	290,418	17,494.37	3,953,565	16,098,314	6,746,909	2,132,000
Total, lode mines	2,151,849	353,026.00	5,900,071	17,730,000	14,534,000	2,344,000
Total, placers		13,581.00	2,705			
	2,151,849	366,607.00	5,902,776	17,730,000	14,534,000	2,344,000

METALLURGIC INDUSTRY

There were large successive increases in Colorado in 1935 and 1936 over 1934 in the quantity of combined gold and gold-silver ores treated by flotation concentration. Concentrates produced from these ores yielded a large part of the State lead output in both years. Equipment for the recovery of gold and silver in ore and concentrates by cyanidation was provided at seven mills in 1936 compared with four in 1935 and three in 1934. Details of cyanidation, flotation, and other plants operating in 1936 are given under the following district reviews.

Custom ore-reduction plants operating in Colorado in 1936 were: The lead bullion-leady copper matte smelter at Leadville; Golden Cycle roast-amalgamation-cyanidation-flotation mill at Colorado Springs; Boulder Mill at Salina, Lehman mill at Jamestown (short period only), and St. Joe sampling plant at Boulder, Boulder County; Humboldt Consolidated (formerly Clear Creek-Gilpin) sampler and mill, Ruth, and Gold Center mills at Idaho Springs, Dumont mill at Dumont, and Watrous mill at Silver Plume, Clear Creek County; War Dance mill, Gilpin County; Bryant mill, Lake County; Alma Milling & Metals Corporation mill, Park County; Shenandoah-Dives mill, San Juan County; Wilfley mill at Kokomo, Summit County; and Cripple Creek mill, Teller County.

Ores were shipped to custom plants in other States in 1936 as follows: Zinc-lead sulphide ore from Lake County to Coffeyville, Kans.; zinc concentrates from Pitkin and Gilpin Counties to Amarillo, Tex.; iron-copper-silver-gold ore from Eagle County, copper-gold-silver concentrates from Clear Creek County, gold-silver-lead-[zinc] ore from Chaffee County, and gold and gold-silver-lead ores and concentrates from the San Juan region to Utah smelters; and zinc-lead-silver-gold ore from Dolores, Gunnison, Lake, and Summit Counties to selective flotation mills at Midvale and Tooele, Utah.

Details of treatment of the total ore produced in Colorado in 1935 and 1936 are shown in the following tables.

Mine production of metals in Colorado, 1935–36, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore and concentrates amalgamated	866,891	53,610.69	21,082			
Ore, concentrates, sands, and slimes cyanided	558,476	122,850.90	56,218			
Concentrates smelted	51,859	115,609.55	909,100	1,281,441	6,614,437	250,000
Ore smelted	272,314	37,846.66	3,705,696	13,372,559	4,730,563	2,153,000
Placer		19,363.00	3,968			
		349,280.80	4,696,064	14,654,000	11,345,000	2,403,000
1936						
Ore and concentrates amalgamated	865,905	63,804.72	17,596			
Ore, concentrates, sands, and slimes cyanided	686,908	133,580.70	48,573			
Concentrates smelted	62,476	123,876.80	1,321,485	1,625,627	8,676,138	747,000
Ore smelted	324,501	31,763.78	4,512,417	16,104,373	5,857,862	1,597,000
Placer		13,581.00	2,705			
		366,607.00	5,902,776	17,730,000	14,534,000	2,344,000

Ore and concentrates treated by amalgamation, ore, concentrates, sands, and slimes treated by cyanidation, and gold and silver contained in bullion and precipitates in Colorado, 1935–36

Process	Material treated	Gold in bullion	Silver in bullion	Quicksilver purchased	Sodium cyanide used
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amalgamation	866,891	53,610.69	21,082	2,765	
Cyanidation	[1] 558,476	122,850.90	56,218		[2] 474,021
1936					
Amalgamation	865,905	63,804.72	17,596	2,077	
Cyanidation	[3] 686,908	133,580.70	48,573		[4] 647,385

[1] Includes 364,037 tons of sands and slimes from ore and concentrates known to have been first roasted and amalgamated, 169,087 tons of estimated tailings from ore first floated and other sands and slimes from iron concentrates first amalgamated, and 25,352 tons of crude ore cyanided.

[2] Reduced to equivalent of 96- to 98-percent strength. Actually 914,818 pounds of cyanamid of approximately 48- to 49-percent strength and 16,612 pounds of sodium cyanide of 96- to 98-percent strength.

[3] Includes 386,710 tons of sands and slimes from ore and concentrates first roasted and amalgamated, 202,019 tons of tailings from ore first floated, 6,064 tons of flotation iron concentrates and 35,363 tons of crude ore first roasted, and 2,437 tons of flotation and table concentrates and 54,315 tons of crude ore cyanided direct.

[4] Reduced to equivalent of 96- to 98-percent strength. Actually 1,065,690 pounds of cyanamid of approximately 48- to 49-percent strength and 114,540 pounds of sodium cyanide of 96- to 98-percent strength.

Mine production of metals from gold and silver mills in Colorado, 1935–36, by counties, in terms of recovered metals

County	Ore treated	Recovered in bullion		Concentrates and recovered metal				
		Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
1935	*Short Tons*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Boulder	63,939	18,148.50	12,489	189	679.00	842	-------	7,800
Chaffee	956	438.56	1,280	68	652.18	2,663	12,500	67,150
Clear Creek	56,494	6,936.07	15,204	2,078	3,495.23	24,252	55,450	140,700
Custer	8	.72	154	-------	-------	-------	-------	-------
Eagle	182	190.91	1,243	-------	-------	-------	-------	-------
Fremont	7	1.20	-------	-------	-------	-------	-------	-------
Gilpin	350,905	9,953.18	19,157	9,972	9,023.29	28,373	27,800	38,050
Gunnison	4,697	1,618.37	1,400	89	133.40	1,586	-------	7,700
Hinsdale	1	20.32	5	-------	-------	-------	-------	-------
Lake	4,503	1,484.30	3,137	201	445.33	3,000	10,100	129,482
La Plata	100	188.87	1,400	2	1.90	-------	-------	-------
Larimer	46	66.94	57	-------	-------	-------	-------	-------
Ouray	27,026	7,168.81	2,281	2,537	4,239.92	78,776	226,321	427,961
Park	3,217	1,526.40	733	29	29.00	29	-------	-------
Pitkin	-------	1.06	-------	-------	-------	-------	-------	-------
Rio Grande	33,649	1,039.00	2,155	1,646	4,285.00	8,577	45,000	-------
Saguache	4,451	106.55	31	80	630.00	225	300	-------
San Juan	-------	11.21	4	-------	-------	-------	-------	-------
San Miguel	44,897	3,231.33	3,005	4,222	5,297.58	139,620	5,388	773,500
Summit	120	41.63	278	-------	-------	-------	-------	-------
Teller	460,448	124,287.66	13,287	-------	-------	-------	-------	-------
	1,055,646	176,461.59	77,300	21,113	28,911.83	287,943	382,859	1,592,343
1936								
Boulder	33,024	11,678.53	6,844	140	300.00	800	6,600	29,000
Chaffee	81	83.66	37	-------	-------	-------	-------	-------
Clear Creek	85,666	14,809.71	8,143	1,659	1,969.20	39,237	128,322	209,504
Custer	421	85.56	788	-------	-------	-------	-------	-------
Eagle	68	352.55	1,180	-------	-------	-------	-------	-------
Gilpin	343,604	10,261.94	17,139	7,007	6,231.29	26,283	14,299	26,485
Gunnison	10,722	2,617.24	1,688	164	219.50	3,500	-------	19,215
Lake	85,880	1,504.65	3,955	3,693	4,019.40	24,858	18,600	218,500
La Plata	33	106.30	58	-------	-------	-------	-------	-------
Larimer	59	74.00	88	-------	-------	-------	-------	-------
Montezuma	-------	463.74	121	-------	-------	-------	-------	-------
Ouray	21,499	5,656.39	1,721	2,005	2,506.30	62,409	200,300	354,000
Park	495	585.71	701	-------	-------	-------	-------	-------
Rio Grande	49,459	4,038.43	4,381	2,462	8,950.71	20,890	70,000	-------
Saguache	3,657	87.60	25	61	206.00	136	-------	110
San Juan	239	179.47	96	-------	-------	-------	-------	-------
San Miguel	61,900	3,256.72	2,661	4,404	5,705.76	108,629	400	791,760
Summit	121	4.22	2	28	17.39	132	-------	4,060
Teller	607,690	141,539.00	16,541	-------	-------	-------	-------	-------
	1,304,618	197,385.42	66,169	21,623	30,125.55	286,874	438,521	1,652,634

Mine production of metals from concentrating mills in Colorado, 1935–36, by counties, in terms of recovered metals

County	Ore treated	Concentrates and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1935							
Boulder	20,887	1,001	2,527.36	6,969	15,300	10,000	
Clear Creek	30,190	3,133	4,615.95	23,887	51,200	256,325	
Gilpin	4,908	685	673.21	12,840	10,450	134,900	
Hinsdale	75	6	.74	803	70	1,500	
Lake	23,583	1,693	1,313.60	7,477	3,450	81,869	
La Plata	11,284	240	1,168.00	11,361		22,900	
Ouray	15,703	643	87.40	139,680	14,300	407,000	
Park	114,401	14,670	58,967.95	40,350	91,350	1,675,050	
Pitkin	9,350	777		106,159		419,300	250,000
San Juan	176,335	6,898	14,517.08	252,782	617,700	1,949,400	
San Miguel	36,308	1,000	2,826.43	19,349	94,762	63,850	
	443,024	30,746	86,697.72	621,157	898,582	5,022,094	250,000
1936							
Boulder	73,005	4,448	13,346.14	50,524	24,260	105,935	
Clear Creek	48,478	5,211	6,688.29	50,624	53,231	300,319	
Gilpin	7,894	1,049	612.53	25,829	14,508	246,548	12,000
Lake	7,320	1,473	930.97	17,286	6,017	476,436	429,000
La Plata	13,066	268	1,070.90	10,641		13,235	
Ouray	19,620	1,687	223.86	329,319	46,700	1,029,000	
Park	117,940	14,054	47,354.96	32,786	19,400	1,463,940	
Pitkin	8,000	642		80,898		300,000	200,000
San Juan	203,174	11,165	21,071.41	421,691	982,430	3,031,631	
San Miguel	23,656	597	2,254.01	13,551	36,360	37,680	
Summit	577	259	198.18	1,462	4,200	18,780	106,000
	522,730	40,853	93,751.25	1,034,611	1,187,106	7,023,504	747,000

Gross metal content of concentrates produced from ores mined in Colorado, 1935–36, by classes of concentrates smelted

Class of concentrates	Concentrates produced (dry weight)	Gross metal content				
		Gold	Silver	Copper (wet assay)	Lead (wet assay)	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1935						
Dry gold	18,610	26,028.64	82,785	162,936	259,290	505,505
Dry gold and silver	124	192.03	4,606	633	7,295	6,748
Dry silver	35		1,823		3,311	
Copper	1,542	3,275.02	25,350	155,756	78,108	586
Copper-lead	8,941	23,277.01	296,859	1,143,264	2,235,620	2,047,459
Lead	22,315	62,852.70	490,736	168,713	4,762,336	1,789,978
Zinc	292		6,941			300,176
	51,859	115,625.40	909,100	1,631,302	7,345,960	4,650,452
1936						
Dry gold	22,213	39,302.91	146,875	201,192	574,280	410,222
Dry gold and silver	724	570.83	12,738	27,788	33,573	10,100
Dry silver	95	13.84	10,011	242	3,713	1,518
Copper	1,716	3,199.99	29,780	212,374	69,770	1,896
Copper-lead	9,566	21,041.95	334,280	1,339,764	1,572,585	1,651,415
Lead	27,271	59,717.07	784,527	223,583	7,371,627	2,377,020
Zinc	891	32.45	4,839	4,148	14,355	855,540
	62,476	123,879.04	1,323,050	2,009,091	9,639,903	5,307,711

Mine production of metals from Colorado concentrates shipped to smelters, 1935-36, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Boulder	1,190	3,206.36	7,811	15,300	17,800	
Chaffee	68	652.18	2,663	12,500	67,150	
Clear Creek	5,211	8,111.18	48,139	106,650	397,025	
Gilpin	10,657	9,696.50	40,713	38,250	172,950	
Gunnison	89	133.40	1,586		7,700	
Hinsdale	6	.74	803	70	1,500	
Lake	1,894	1,758.93	10,477	13,550	211,351	
La Plata	242	1,169.90	11,361		22,900	
Ouray	3,180	4,327.32	218,456	240,621	834,961	
Park	14,699	58,996.95	40,379	91,350	1,675,050	
Pitkin	777		106,159		419,300	250,000
Rio Grande	1,646	4,285.00	8,577	45,000		
Saguache	80	630.00	225	300		
San Juan	6,898	14,517.08	252,782	617,700	1,949,400	
San Miguel	5,222	8,124.01	158,969	100,150	837,350	
	51,859	115,609.55	909,100	1,281,441	6,614,437	250,000
1936						
Boulder	4,588	13,646.14	51,324	30,860	134,935	
Clear Creek	6,870	8,657.49	89,861	181,553	509,823	
Gilpin	8,056	6,843.82	52,112	28,807	273,033	12,000
Gunnison	164	219.50	3,500		19,215	
Lake	5,166	4,950.37	42,144	24,617	694,936	429,000
La Plata	268	1,070.90	10,641		13,235	
Ouray	3,692	2,730.16	391,728	247,000	1,383,000	
Park	14,054	47,354.96	32,786	19,400	1,463,940	
Pitkin	642		80,898		300,000	200,000
Rio Grande	2,462	8,950.71	20,890	70,000		
Saguache	61	206.00	136		110	
San Juan	11,165	21,071.41	421,691	982,430	3,031,631	
San Miguel	5,001	7,959.77	122,180	36,760	829,440	
Summit	287	215.57	1,594	4,200	22,840	106,000
	62,476	123,876.80	1,321,485	1,625,627	8,676,138	747,000

BY CLASSES OF CONCENTRATES SMELTED

	Concentrates	Gold	Silver	Copper	Lead	Zinc
1935						
Dry gold	18,610	26,012.79	82,785	130,400	231,341	
Dry gold and silver	124	192.03	4,606	450	6,575	
Dry silver	35		1,823		2,300	
Copper	1,542	3,275.02	25,350	138,300	71,650	
Copper-lead	8,941	23,277.01	296,859	876,521	2,012,762	
Lead	22,315	62,852.70	490,736	135,770	4,289,809	
Zinc	292		6,941			250,000
	51,859	115,609.55	909,100	1,281,441	6,614,437	250,000
1936						
Dry gold	22,213	39,302.91	146,875	160,335	516,676	
Dry gold and silver	724	570.83	12,738	20,033	30,192	
Dry silver	95	13.84	10,011	169	3,365	
Copper	1,716	3,199.99	29,780	194,000	53,541	
Copper-lead	9,566	21,041.95	334,280	1,072,004	1,415,506	
Lead	27,271	59,717.07	784,527	175,444	6,648,745	
Zinc	891	30.21	3,274	3,642	8,113	747,000
	62,476	123,876.80	1,321,485	1,625,627	8,676,138	747,000

Gross metal content of Colorado crude ore shipped to smelters, 1935–36, by classes of ore

Class of ore	Ore		Gross metal content				
			Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Percent*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	24,237	8.90	22,090.95	91,696	86,966	574,705	36,648
Dry gold and silver	2,039	.75	808.44	39,276	7,764	56,303	6,064
Dry silver	16,508	6.06	53.23	606,739	4,976	519,390	12,027
Copper	209,492	76.93	8,529.28	2,789,222	13,629,062	565,106	4,186,340
Copper-lead	295	.11	89.70	6,550	29,728	87,991	
Lead	10,499	3.86	5,447.86	103,882	36,789	2,634,777	47,738
Lead-zinc	9,244	3.39	827.77	68,334	30,015	1,208,070	2,611,735
	272,314	100.00	37,847.23	3,705,699	13,825,300	5,646,342	6,900,552
1936							
Dry gold	13,136	4.05	15,119.49	47,915	51,666	360,932	53,116
Dry gold and silver	4,475	1.38	1,310.67	33,807	15,220	102,100	15,864
Dry silver	34,330	10.58	279.74	613,661	15,229	1,194,706	13,317
Copper	253,871	78.23	10,569.34	3,693,303	16,595,827	1,969,969	5,074,880
Copper-lead	910	.28	15.86	15,740	79,831	304,266	
Lead	11,423	3.52	4,164.21	92,537	38,669	2,712,810	372,261
Lead-zinc	6,356	1.96	305.24	15,490	15,767	901,859	1,948,259
	324,501	100.00	31,764.55	4,512,453	16,812,209	7,546,642	7,477,697

Mine production of metals from Colorado crude ore shipped to smelters, 1935–36, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Boulder	692	498.14	13,684	2,700	31,200	
Chaffee	331	217.06	3,399	9,500	32,850	
Clear Creek	2,078	1,114.35	37,553	23,350	160,975	
Custer	228	.08	7,494	4,000	37,100	
Dolores	1,082	655.54	71,040	25,000	280,500	283,000
Eagle	210,405	9,659.89	2,791,013	13,183,000	309,000	
Gilpin	1,589	558.72	17,730	20,750	57,050	
Gunnison	549	267.17	7,062		59,100	
Hinsdale	21	124.14	184	930	1,700	
Lake	30,600	11,020.97	100,626	47,450	2,370,349	1,848,000
La Plata	201	808.63	4,167		500	
Las Animas	1	.11	14		100	
Mineral	9,312	21.51	499,680		351,800	
Moffat	19	.20	46	6,000		
Montezuma	81	273.06	562			
Ouray	685	1,001.87	5,439	12,379	22,239	22,000
Park	4,122	6,611.45	20,342	650	233,450	
Pitkin	6,530		68,049		124,000	
Rio Grande	1,297	2,795.00	1,691			
Saguache	199	1.88	4,384	17,700	61,500	
San Juan	1,038	1,260.11	29,454	6,300	468,800	
San Miguel	379	371.58	10,940	4,850	22,850	
Summit	875	585.20	11,143	8,000	105,500	
	272,314	37,846.66	3,705,696	13,372,559	4,730,563	2,153,000
1936						
Boulder	204	264.73	883	1,140	65	
Chaffee	1,447	1,494.54	13,728	18,000	234,000	
Clear Creek	1,431	893.00	13,872	5,847	68,477	
Custer	241	6.44	5,110	2,300	44,000	
Dolores	808	308.60	20,031	14,000	238,000	279,000
Eagle	254,900	11,592.85	3,696,452	15,932,700	982,800	
Gilpin	946	714.44	7,778	3,193	55,667	
Gunnison	80	31.06	568		6,785	5,000
Hinsdale	29	90.60	62		400	
Lake	24,921	7,235.58	87,706	18,383	2,412,064	1,313,000
La Plata	16	27.40	352		65	
Mesa	14		14	1,000		
Mineral	10,738		422,071		370,800	
Montezuma	216	1,129.46	3,293	2,000		
Ouray	392	565.25	12,715	3,500	27,000	
Park	1,990	4,992.53	16,194	5,600	170,060	
Pitkin	18,700	4.60	117,421		369,000	
Routt	9	2.06	444	200	3,600	
Saguache	934	21.66	16,169	65,000	278,590	
San Juan	868	909.12	10,816	8,970	81,269	
San Miguel	4,254	950.31	42,343	14,240	304,560	
Summit	1,363	529.55	24,395	8,300	210,660	
	324,501	31,763.78	4,512,417	16,104,373	5,857,862	1,597,000

Mine production of metals from Colorado crude ore shipped to smelters, 1935–36, in terms of recovered metals—Continued

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	24, 237	22, 090. 38	91, 693	68, 354	515, 725	
Dry gold and silver	2, 039	808. 44	39, 276	6, 634	50, 550	
Dry silver	16, 508	53. 23	606, 739	3, 980	466, 619	
Copper	209, 492	8, 529. 28	2, 789, 222	13, 216, 180	311, 900	
Copper-lead	295	89. 70	6, 550	23, 750	79, 200	
Lead	10, 499	5, 447. 86	103, 882	29, 395	2, 371, 103	
Total to copper and lead plants	263, 070	37, 018. 89	3, 637, 362	13, 348, 293	3, 795, 097	
Lead-zinc	9, 244	827. 77	68, 334	24, 266	935, 466	2, 153, 000
	272, 314	37, 846. 66	3, 705, 696	13, 372, 559	4, 730, 563	2, 153, 000
1936						
Dry gold	13, 136	15, 119. 49	47, 915	42, 039	323, 789	
Dry gold and silver	4, 475	1, 310. 67	33, 807	12, 194	92, 013	
Dry silver	34, 330	279. 74	613, 661	13, 177	1, 067, 058	
Copper	253, 871	10, 569. 34	3, 693, 303	15, 930, 055	987, 107	
Copper-lead	910	15. 86	15, 740	65, 540	271, 500	
Lead	11, 423	4, 163. 44	92, 501	28, 655	2, 432, 714	
Total to copper and lead plants	318, 145	31, 458. 54	4, 496, 927	16, 091, 660	5, 174, 181	
Lead-zinc	6, 356	305. 24	15, 490	12, 713	683, 681	1, 597, 000
	324, 501	31, 763. 78	4, 512, 417	16, 104, 373	5, 857, 862	1, 597, 000

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Colorado, 1935–36, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
1935			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Adams County		19			45.34	45.34		7	7				$1,592
Arapahoe County		33			60.26	60.26							2,109
Boulder County:													
Central	30		4,086	2,272.60		2,272.60	3,108		3,108	4,700	16,500		82,825
Gold Hill	68	4	34,005	6,680.00	19.97	6,699.97	12,224	3	12,227	11,300	8,900		244,581
Grand Island	16	4	1,127	642.60	209.03	851.63	10,869	11	10,880		10,900		38,063
Magnolia	21		5,052	1,599.40		1,599.40	50		50				56,015
Sugar Loaf	49	9	37,555	10,057.60	549.20	10,606.80	6,421	50	6,471		10,100		376,293
Ward	34		3,693	600.80		600.80	1,312		1,312	2,000	2,600		22,241
Chaffee County:													
Arkansas River		10			17.46	17.46		1	1				612
Chalk Creek	2		978	1,108.63		1,108.63	6,361		6,361	13,500	85,400		47,911
Four Mile	1	2	53	22.34	3.43	25.77	2		2				903
Granite [1]	6	20	78	120.92	223.14	344.06	46	49	95		800		12,142
Monarch	1		10	.20		.20	72		72	800	4,300		297
Riverside	3		101	47.17		47.17	775		775	2,000	9,500		2,754
Turret	1		67	8.54		8.54	86		86	5,700			834
Clear Creek County:													
Alice	9		13,642	1,443.20		1,443.20	4,359		4,359	24,650	10,700		56,119
Argentine	5		406	18.80		18.80	8,498		8,498		14,700		7,354
Empire	21		19,075	4,573.80		4,573.80	1,006		1,006	700	12,800		161,376
Geneva Creek	1		14	28.00		28.00	1,198		1,198	1,300			1,949
Griffith	17		1,132	108.94		108.94	10,343		10,343	800	15,500		11,933
Idaho Springs	72	81	49,165	8,767.20	209.40	8,976.60	64,402	39	64,441	98,400	442,900		386,381
Montana	12		1,114	41.26		41.26	6,727		6,727	300	17,200		6,992
Trail Creek	8		4,214	1,180.40		1,180.40	4,363		4,363	3,850	44,200		46,538
Costilla County: Grayback		1			2.00	2.00							70
Custer County:													
Hardscrabble	5		230	.17		.17	7,499		7,499	4,000	37,100		7,212
Rosita Hills	1		6	.63		.63	149		149				129
Delta County		1			1.20	1.20							42
Denver County		59			39.34	39.34							1,377
Dolores County: Pioneer	7		1,082	655.54		655.54	71,040		71,040	25,000	280,500	283,000	99,751
Douglas County		27			71.80	71.80							2,513
Eagle County:													
Burns		7			59.06	59.06		14	14				2,077
Red Cliff	14		210,587	9,850.80		9,850.80	2,792,256		2,792,256	13,183,000	309,000		3,458,261

Elbert County		2			6.94	6.94							243
Fremont County:													
Arkansas River		11			42.63	42.63		7	7				1,497
Hillside	1		7	1.20		1.20							42
Gilpin County:													
Southern	90	130	356,313	19,950.83	730.43	20,681.26	76,643	213	76,856	44,000	229,900		791,932
Northern	19	24	1,089	257.57	88.17	345.74	957	11	968	15,000	100		14,046
Grand County		3			2.83	2.83							99
Gunnison County:													
Elk Mountain	4	1	520	28.74	2.49	31.23	3,637		3,637		650		3,733
Gold Brick	13		4,578	1,985.23		1,985.23	4,345		4,345		22,400		73,502
Quartz Creek	2		25	1.09		1.09	199		199		750		211
Rock Creek	1		3	.40		.40	199		199				157
Taylor Park (Tin Cup)	3	12	48	.88	37.17	38.05	526	7	533		7,000		1,995
Tomichi	2		72	2.60		2.60	1,142		1,142		36,000		2,352
Hinsdale County:													
Galena	2		77	1.14		1.14	843		843	400	1,550		741
Lake	2		20	144.06		144.06	149		149	600	1,650		5,265
Jackson County		7			18.57	18.57							650
Jefferson County		48			4,623.14	4,623.14		640	640				162,270
Lake County:													
Alicante	2		9	2.51		2.51	32		32		1,600		175
California (Leadville)	41	19	58,164	13,811.51	340.23	14,151.74	109,504	82	109,586	61,000	2,575,000	1,848,000	763,451
Granite [1]	1	7	34	54.09	21.17	75.26	32	3	35				2,659
Lackawanna Gulch	1		33	180.29		180.29	50		50				6,346
St. Kevin	2		342	95.71		95.71	4,423		4,423		2,000		6,609
Tennessee Pass	1		89	79.80		79.80	64		64				2,839
Twin Lakes	1	2	15	40.29	1,354.60	1,394.89	135	441	576		3,100		49,359
La Plata County:													
California	14	4	11,578	2,149.00	13.14	2,162.14	16,925		16,925		23,400		88,776
Vallecito	1		7	18.40		18.40	3		3				646
Larimer County:													
Manhattan	1		2	1.97		1.97	1		1				70
Masonville	2		44	64.97		64.97	56		56				2,314
Las Animas County	1		1	.11		.11	14		14		100		18
Mesa County		11			8.74	8.74							306
Mineral County	7		9,312	21.51		21.51	499,680		499,680		351,800		373,970
Moffat County:													
Douglas Mountain	1		19	.20		.20	46		46	6,000			538
Fourmile (Timberlake)		8			123.11	123.11		7	7				4,314
Lay		2			3.69	3.69							129
Montezuma County	2		81	273.06		273.06	562		562				9,961
Montrose County:													
La Sal		23			122.60	122.60		28	28				4,311
Naturita		35			178.49	178.49		54	54				6,286
Ouray County:													
Red Mountain	1		19				60		60	200	4,800	5,000	472
Ridgway		8			22.03	22.03		7	7				776
Sneffels	4		27,047	11,414.97		11,414.97	81,280		81,280	226,400	429,700	1,000	493,967
Uncompahgre	6		16,348	1,083.03		1,083.03	144,836		144,836	26,400	422,700	16,000	161,810

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Colorado, 1935–36, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
1935—Continued			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Park County:													
Alma Placers		1			3,007.43	3,007.43		612	612				$105,700
Beaver Creek		5			44.23	44.23		4	4				1,551
Buckskin	8	8	867	350.20	16.52	366.72	1,017	3	1,020		4,750		13,758
Consolidated Montgomery	7		1,072	446.74		446.74	1,312		1,312		3,800		16,731
Fairplay		25			601.43	601.43		128	128				21,142
Mosquito	16	2	119,775	66,330.40	16.25	66,346.65	59,125		59,125	92,000	1,899,950		2,448,263
Tarryall	2	36	26	7.46	1,122.20	1,129.66		93	93				39,605
Pitkin County:													
Lincoln Gulch	1			1.06		1.06							37
Roaring Fork	3		15,880				174,208		174,208		543,300	250,000	157,944
Rio Grande County: Summitville	1		34,946	8,119.00		8,119.00	12,423		12,423	45,000			296,829
Routt County: Hahns Peak		8			32.00	32.00		8	8				1,126
Saguache County:													
Blake	1		20	7.55		7.55							264
Crestone	1		4,431	729.00		729.00	256		256	300			25,724
Kerber Creek	5		199	1.88		1.88	4,384		4,384	17,700	61,500		7,146
San Juan County:													
Animas	13	3	177,262	14,678.97	5.63	14,684.60	276,978	3	276,981	624,000	2,415,500		861,453
Eureka	2	1	111	1,109.43	333.97	1,443.40	5,262	175	5,437		2,700		54,535
San Miguel County:													
Iron Springs	7		157	113.52		113.52	8,889		8,889	3,950	18,750		11,440
Lower San Miguel	2	12	6	3.29	25.23	28.52	32	11	43		200		1,037
Mount Wilson	2		13	52.94		52.94	139		139		350		1,967
Upper San Miguel	17	11	81,408	11,557.17	22.17	11,579.34	163,854	7	163,861	101,050	840,900		565,075
Summit County:													
Breckenridge	15	77	557	356.92	4,787.60	5,144.52	8,448	1,240	9,688	7,050	79,850		190,800
Montezuma	5		95	57.88		57.88	1,760		1,760	950	21,650		4,236
Ten Mile	8	11	343	212.03	61.20	273.23	1,213	8	1,221		4,000		10,601
Teller County: Cripple Creek	122	8	460,448	124,287.66	36.34	124,324.00	13,287	2	13,289				4,360,891
Total Colorado	870	842	1,770,984	329,917.80	19,363.00	349,280.80	4,692,096	3,968	4,696,064	14,654,000	11,345,000	2,403,000	17,375,938
1936													
Adams County		13			85.20	85.20		13	13				2,992
Arapahoe County		6			38.00	38.00							1,330
Boulder County:													
Central	19		10,654	2,824.60		2,824.60	2,106		2,106	150			100,506
Gold Hill	64	1	47,075	10,737.60	3.80	10,741.40	35,508		35,508	30,130	78,600		409,838
Grand Island	9	2	8,497	845.94	93.60	939.54	11,286	5	11,291	350	47,765		43,858

Magnolia	22		4,262	1,212.80		1,212.80	124		124				42,544
Sugar Loaf	36	8	34,660	9,113.80	276.40	9,390.20	9,264	26	9,290	1,090	6,680		336,259
Ward	23		1,085	854.66		854.66	763		763	280	1,955		30,620
Chaffee County:													
Chalk Creek	4		1,213	1,324.34		1,324.34	11,654		11,654	15,935	205,700		66,306
Four Mile	1		22	29.40		29.40							1,029
Granite [1]	7	20	81	118.60	108.00	226.60	213	13	226	65	4,200		8,305
Riverside	3		190	94.80		94.80	1,756		1,756	1,820	24,100		5,954
Trout Creek	2		10	1.20		1.20	142		142	180			169
Turret	2		12	9.86		9.86							345
Clear Creek County:													
Alice	6		26,980	2,830.14		2,830.14	12,878		12,878	119,000	200		119,986
Argentine	2		3,566	405.11		405.11	6,581		6,581	18,000	26,500		22,151
Empire	10		34,750	11,571.11		11,571.11	1,601		1,601	800	300		406,317
Geneva Creek	1		347	164.40		164.40	2,909		2,909				8,007
Griffith	10		1,284	200.49		200.49	7,157		7,157	1,400	27,000		13,931
Idaho Springs	48	51	55,835	6,526.86	81.40	6,608.26	73,570	9	73,579	45,100	481,800		314,588
Montana	7		258	12.49		12.49	1,823		1,823		6,700		2,157
Trail Creek	7		12,555	2,649.60		2,649.60	5,357		5,357	3,100	35,800		98,817
Costilla County: Grayback		3			13.20	13.20		1	1				463
Custer County:													
Hardscrabble	6		360	51.57		51.57	2,913		2,913	1,870	9,300		4,661
Rosita Hills	4		302	40.43		40.43	2,985		2,985	430	34,700		5,363
Dolores County: Pioneer	3		808	308.60		308.60	20,031		20,031	14,000	238,000	279,000	52,501
Douglas County		10			24.40	24.40							854
Eagle County:													
Burns		1			1.60	1.60							56
Red Cliff	15		254,968	11,945.40		11,945.40	3,697,632		3,697,632	15,932,700	982,800		4,792,922
Fremont County		1			2.80	2.80							98
Gilpin County:													
Southern	64	93	346,317	16,788.40	4,703.40	21,491.80	76,847	913	77,760	31,800	328,700	12,000	831,084
Northern	12	15	6,127	1,031.80	46.20	1,078.00	182	5	187	200			37,893
Grand County		5			4.60	4.60							161
Gunnison County:													
Elk Mountain	4	2	67	19.00	1.80	20.80	430		430		5,600	5,000	1,569
Gold Brick	5		10,735	2,848.80		2,848.80	5,326		5,326		20,400		104,771
Taylor Park (Tin Cup)		13			34.00	34.00		9	9				1,197
Hinsdale County	1		29	90.60		90.60	62		62		400		3,237
Jefferson County		34			106.20	106.20		22	22				3,734
Lake County:													
California (Leadville)	47	3	116,971	13,323.94	1,429.40	14,753.34	120,027	226	120,253	43,000	3,100,900	1,742,000	843,200
Other districts [2]	8	8	1,150	366.66	164.80	531.46	13,778	31	13,809		6,100		29,577
La Plata County:													
California	11		13,109	1,194.60		1,194.60	11,050		11,050		13,300		50,981
Vallecito	1		6	10.00		10.00	1		1				351
Larimer County	2		59	74.00		74.00	88		88				2,658
Mesa County	1	9	14		4.00	4.00	14		14	1,000			243
Mineral County: Creede	8		10,738				422,071		422,071		370,800		343,951
Moffat County:													
Fourmile (Timberlake)		10			210.54	210.54		13	13				7,379
Lay		3			8.26	8.26							289

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Colorado, 1935–36, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	Fine ounces	Fine ounces	Fine ounces	Fine ounces	Fine ounces	Fine ounces	Pounds	Pounds	Pounds	
1936—Continued													
Montezuma County	3		216	1,593.20		1,593.20	3,414		3,414	2,000			$58,590
Montrose County:													
La Sal		13			84.80	84.80		18	18				2,982
Naturita		32			76.40	76.40		26	26				2,694
Ouray County:													
Red Mountain	1		350	50.80		50.80	1,224		1,224	5,700	10,000		3,710
Sneffels	3		21,557	8,376.18		8,376.18	64,227		64,227	200,300	354,000		377,622
Uncompahgre	3	2	19,604	524.82	27.40	552.22	340,713	80	340,793	44,500	1,046,000		335,482
Park County:													
Alma Placers		74			2,271.60	2,271.60		457	457				79,860
Beaver Creek		4			461.91	461.91		93	93				16,239
Buckskin	7		136	114.03		114.03	1,437		1,437	400	1,700		5,219
Consolidated Montgomery	3		277	156.60		156.60	400		400	400	3,800		6,003
Fairplay		20			149.37	149.37		31	31				5,252
Mosquito	14	3	120,012	52,662.57	19.80	52,682.37	47,844	4	47,848	24,200	1,628,500		1,958,078
Tarryall		35			431.32	431.32		36	36				15,124
Pitkin County:													
Avalanche	1		8	4.60		4.60	8		8		3,000		305
Roaring Fork	2		26,692				198,311		198,311		666,000	200,000	194,228
Rio Grande County: Summitville	1		49,459	12,989.14		12,989.14	25,271		25,271	70,000			480,632
Routt County: Hahns Peak	1	11	9	2.06	28.00	30.06	444	9	453	200	3,600		1,587
Saguache County:													
Crestone	2		3,658	296.46		296.46	183		183	140	610		10,559
Kerber Creek	4		928	13.20		13.20	16,130		16,130	64,720	277,720		31,684
Music	1		5	5.60		5.60	17		17	140	370		239
San Juan County:													
Animas	22		203,972	21,539.88		21,539.88	425,831		425,831	991,300	3,082,400		1,316,692
Eureka	2	1	172	580.49	2.00	582.49	4,036		4,036	100	2,500		23,637
Ice Lake	1		137	39.63		39.63	2,736		2,736		28,000		4,794
San Miguel County:													
Iron Springs	8		3,986	297.00		297.00	38,470		38,470	13,500	294,700		54,988
Lower San Miguel	2	9	36	9.40	10.40	19.80	439	5	444		1,890		1,124
Mount Wilson	2		22	74.20		74.20	222		222		840		2,808
Upper San Miguel	11	7	85,766	11,786.20	54.40	11,840.60	128,053	22	128,075	37,500	836,570		555,547
Summit County:													
Breckenridge	14	64	867	519.46	2,449.06	2,968.52	13,286	633	13,919	6,100	60,900	96,000	122,840
Montezuma	4		475	9.91		9.91	11,778		11,778	6,400	171,000	10,000	18,424
Ten Mile	5		719	219.97		219.97	927		927		1,600		8,491
Wilkinson		2			3.74	3.74		1	1				122
Teller County: Cripple Creek	122	13	607,690	141,539.00	69.20	141,608.20	16,541	4	16,545				4,969,101
Total Colorado	714	601	2,151,849	353,026.00	13,581.00	366,607.00	5,900,071	2,705	5,902,776	17,730,000	14,534,000	2,344,000	19,819,869

[1] The Granite district lies in both Chaffee and Lake Counties. [2] Includes Granite, Lackawanna Gulch, St. Kevin, Tennessee Pass, and Twin Lakes districts.

ADAMS COUNTY

Individuals working intermittently with sluices and small placer machines along Clear Creek and South Platte River produced most of the output of gold from Adams County in 1936. The remainder was recovered during January, February, and March by temporary sluice boxes placed below waste flumes of the Gordon sand and gravel plant.

ARAPAHOE COUNTY

The output from Arapahoe County in 1936 comprised gold dust and amalgam retorts produced by individuals at small placers on Cherry and Dry Creeks and their tributaries southeast of Denver. All the output was sold in small lots to bullion buyers in Denver.

BOULDER COUNTY

In 1936 the principal markets for Boulder County ores and concentrates were the Golden Cycle mill at Colorado Springs and the A. V. smelter at Leadville. At its sampler at Boulder, the St. Joe Mining & Milling Co.[2] purchased ore, mostly in less-than-carload lots, and reshipped it to the Golden Cycle mill. At Salina the Boulder Mill, Inc., concentrated ores from mines in the various districts of Boulder County in its 100-ton flotation mill, at a specified charge per ton, until near the end of the year when the company began to purchase ores. Seven miles southeast of Boulder near Marshall the Capitol Refining Co. erected a custom ore-reduction plant designed to treat high-grade gold ores and concentrates. Test runs on several lots of concentrates in August and September proved unsuccessful, and the plant was closed. In December the Colorado Smelting & Refining Co. of Denver took over the plant and by May 30, 1937, had removed part of the equipment and enlarged the building to make room for a roasting furnace (Herreshoff type), additional ball mills, flotation cells, tables, and other equipment with which the company plans to start a 100-ton roast-amalgamation-flotation custom plant in August or September 1937.

Central district (Jamestown).—The Wano group produced the bulk of the output of metals from the Jamestown district in 1936. Part of the ore was mined and shipped by lessees to the Golden Cycle mill at Colorado Springs, and part was mined on company account and either shipped to the Golden Cycle mill or, if too low in grade for direct shipment, was concentrated in the company flotation mill; the concentrates were shipped, some to the Leadville smelter and some to the Golden Cycle mill. Other producers in the Jamestown district included the Acme, Cracker Jack, Eureka, Fourth of July, Gold Finch, Golden Age group, Gray Eagle, John Jay, Last Chance, McKinley, and Smuggler. The Lehman mill at Jamestown was operated for a short period on ore from the Grouse mine. Erection of the 40-ton mill of the Acme Mining & Milling Co., designed to treat ore from the John Jay mine, was completed in 1936, but the mill was not placed in operation.

Gold Hill district.—The Slide Mines, Inc., continued in 1936 to mine and mill ore from its properties opened by the Corning Tunnel. The ore is treated in the gravity- and flotation-concentration mill at

[2] Mining and milling operations of the St. Joe Mining & Milling Co. are mentioned in the district reviews.

the mouth of the tunnel. Additions to the mill in 1936 included a washing and sorting plant and steam-heating equipment. The capacity of the mill at the end of 1936 was 70 tons daily. The United Empire Gold Mines Co. operated the 125-ton flotation mill, built at its property at Sunshine in 1935, at less than full capacity for 341 days in 1936, chiefly on dump ore and old stope fillings. At the Ingram mine the Mines Development Corporation unwatered the lower levels, extended the southwest drift on the 710-foot level 170 feet, and deepened the shaft 100 feet. Custom ore treated at the Boulder Mill from mines in the Gold Hill district came largely from the Ingram, Big Horn, Minneapolis, Fairfax, Emancipation, and Grant, listed in order of tonnage milled. Part of the ore produced from several of these mines was shipped to the Golden Cycle mill. Some of the other producing mines in the Gold Hill district in 1936 were the Baron group (Garfield Charles), Buena Ventura, Evans, Evening Star, Golden Harp, Goldsmith Maid, Nil Desperandum, Plow Boy, Prussian, Richmond group, Scotia, Sunshine, Seven-Thirty, Tippecanoe, Washburn, and Winona. A small sluicing operation on Left Hand Creek yielded a little placer gold.

Grand Island district (Cardinal, Caribou, Eldora, and Nederland).—The Rocky Mountain Gold Mines, Inc., operated its 100-ton flotation mill at Cardinal at less than capacity on ore from the Boulder County group from March 1 to August 1, 1936, when the company suspended operations. The product of the mill was gold-silver-lead concentrates, which were shipped to the A. V. smelter at Leadville. From June through December the Cross Gold Mining Co. drove 389 feet of drifts and raises at the Cross group and shipped a few cars of ore. Other producing mines in the Grand Island district in 1936 were the Amy Paul, Enterprise group, St. Louis, Sweet Home, and Stranger. Small lots of ore were shipped from two prospects in the district. Placer gold was recovered by individuals sluicing on Beaver Creek.

Magnolia district.—Most of the metal output from the Magnolia district in 1936 was contained in crude ore shipped to the Golden Cycle mill, a large part of which came from dumps. The principal producing mines and dumps were: American X, Ben C. Lowell, Cash, Graphic, Hereafter, India, KeKeonga, Keystone, Lady Franklin, Little Pittsburg, Mary V, New Year-Fortune, Pickwick, Poorman, and Senator Hill.

Sugar Loaf district.—The Grand Republic mine of the St. Joe Mining & Milling Co. was operated continuously in 1936 and was again the largest producer of gold in Boulder County. The inclined shaft begun in 1934 had been sunk to a depth of 280 feet by the end of 1936, with working levels established at 50, 100, 160, 220, and 280 feet. Development done in 1936 totaled 3,320 feet. The ore was trucked to the St. Joe 100-ton flotation mill on Left Hand Creek (Gold Hill district) for treatment until October 1 when the company closed that mill, due to the difficulty and expense of maintaining tailing dams, and moved the equipment to a new plant completed and placed in operation late in November at Valmont near Boulder. Ore mined between October 1 and the time the new mill was completed was shipped to the Golden Cycle mill. Lessees at the Poorman mine continued to ship ore to the Golden Cycle mill and the sampler at Boulder. Ore from the Nancy, Livingston, and Logan groups was shipped to the Golden Cycle mill, Boulder Mill, and Boulder Sampling Works. Other important producers in the Sugarloaf district were the

Concord, Dolly Varden, Empress, Herold, Milan, Recluse, Red Signe, Smoky Hill, Wisconsin, Wood Mountain, and Yellow Pine. Most of the placer gold recovered in the district came from a power shovel and movable washing and amalgamating plant operated at the Colby-Giggey placers.

Ward district.—The Golden Queen mine in Left Hand Gulch 1 mile from Ward, operated continuously, was the principal producer of metals in the Ward district in 1936. The ore was shipped to the Garfield (Utah) smelter and the Golden Cycle mill. The other output from the district comprised gold ore shipped from the Chief claim, East Columbia, Milwaukee, Nelson, Richard, Stoughton, and Ward Rose; silver ore from the Black Jack claim; and miscellaneous small lots of ore, mostly samples shipped from prospects.

CHAFFEE COUNTY

Chalk Creek district (Romley, St. Elmo).—In 1936 lessees at the Mary Murphy mine continued to produce most of the output of metals from Chaffee County from gold-silver-lead-copper-[zinc] ore shipped to custom mills or smelters for treatment. The Philip Carey Mining & Milling Co. unwatered the Lilly winze and Quincy shaft and shipped one lot of silver ore to the Leadville smelter. Several lots of silver-lead ore were shipped from the Allie Bell group, and one lot of silver-lead-gold ore was shipped from another property in the district, all to the Leadville smelter.

Four Mile district.—Lessees operated the Little Annie C. C. group most of 1936 and shipped several lots of gold ore to the Leadville smelter.

Granite district.—Operators of lode mines in the Granite district in 1936 shipped small lots of smelting ore from the Florence Extension, Trafalgar, and other properties. The H. & H. Mining Co. shipped a car of gold ore from the Granite Tunnel to the Golden Cycle mill. Placer gold was recovered from the Bugtown, Cache Creek, Franklin, Georgia Bar, Old Channel, and other placers near Granite.

Riverside district.—Continuing operations begun in 1935 at the Mount Harvard group, the Williams Mining Co. shipped three cars of gold-silver-lead-[zinc]-copper ore to the Leadville smelter in 1936. In July the company closed the mine and gave up its lease. Two lots of gold ore shipped from the Big Chief property and a car of gold-silver-lead ore shipped from the Blue Flag comprised the other output from the Riverside district in 1936.

Trout Creek district.—Lessees operated the Dolomite group from January 1 to August 28, 1936, during which time they retimbered 100 feet of shaft, sank a 100-foot winze, drove 340 feet of tunnel, and did 50 feet of trenching on the surface. They produced and shipped 8 tons of silver ore. A small lot of ore was shipped from the Nelly Bly prospect. Diamond drilling was done at the Iron Chest group 1 mile west of Trout Creek Pass on Trout Creek.

Turret district.—Emil Becker shipped one lot of gold ore from the Monongahela claim to the Golden Cycle mill early in 1936 and during the year drove 167 feet of tunnel at the property. A small lot of gold ore was shipped from a prospect in the Turret district.

CLEAR CREEK COUNTY

Alice district (*Yankee, Lincoln*).—The Alice property was the chief producer in the Alice district in 1936. Reopened in 1935 by the Porphyry Mines, Inc., and equipped with an 80-ton amalgamation-flotation concentration mill, the mine was operated by that company until March 4, 1936, when the American Smelting & Refining Co. took it over and proceeded to carry out a program of mine development and surface improvements. Parts of the mine-development program completed in 1936 included a 225-foot inclined main shaft, a 125-foot inclined prospecting shaft, and about 700 feet of drifts and raises. Slushing replaced mucking and tramming in the mine. Surface improvements completed included the installation of new crushing equipment, ore-conveyor belts, ore bins, and enlargement of the mill to raise its capacity from 80 to 200 tons per 24 hours. The ore is crushed by a 15- by 38-inch Telsmith-Wheeling jaw crusher and is ground by a No. 66 Marcy ball mill in closed circuit with a Dorr classifier and a Clark-Todd amalgamator. The overflow from the classifier is conditioned and treated by selective flotation (copper over iron) in a 6-cell and a 4-cell sub-"A" flotation machine. The products of the mill are gold-copper-silver-[iron] concentrates which are shipped to the company smelters at Garfield, Utah, and Leadville, Colo., and gold-silver bullion which is shipped to the Denver Mint.

Small stamp-amalgamation mills were used in 1936 to treat ore from the Lalla and Reynolds mines, and some ore was shipped from the Lombard and Ottawa groups and the Ethel prospect.

Argentine district.—The 50-ton flotation mill built in 1935 at the Santiago mine was operated for 100 days in 1936, from June to September, and treated about 3,500 tons of ore from the Santiago dump. Gold-silver-copper concentrates produced at this mill and 66 tons of crude ore from the Santiago mine and Blue Bell group yielded the total output of metals from the Argentine district in 1936.

Empire district.—The Minnesota Mines, Inc., operated its Crown Prince-Atlantic-Comet consolidated group of mines and 100-ton cyanide plant continuously in 1936 and was the largest producer of gold in Clear Creek County. The ore was treated by the all-sliming cyanide process, but late in the year the company began to install flotation equipment with which to concentrate the ore before cyanidation and increase the capacity of the mill to 200 tons daily. Mine timbering at the Conqueror group was repaired, and the 50-ton flotation-gravity concentration mill was reconditioned and operated for a short period in the last part of the year. Other producing mines and dumps in the Empire district were the Bard Creek, Cashier, Gold Bug, Gold Dirt, Gold Fissure, Mint, Pittsburg, and Tenth Legion.

Geneva Creek district.—The output from the Geneva Creek district in 1936 comprised gold-silver ore shipped from the dump of the Sill property to the A. V. smelter at Leadville.

Griffith (*Georgetown-Silver Plume*) *district*.—The Watrous 65-ton custom flotation mill near Silver Plume was run for short periods in 1936 on ore from the Rio Grande-Zeda mine and from the Blue Bell group (Argentine district). Ore was shipped to the Leadville smelter and local custom mills from the Amy, Backbone, Capital Prize, Commonwealth Tunnel, Griffith, and Odin properties and three prospects.

Idaho Springs district.—The Alma Lincoln Mining Co. was the leading producer of metals in the Idaho Springs district in 1936. The ore

came from the Lincoln (lower levels) and Elliott-Barber mines and was treated in the company 100-ton flotation mill. The new 60-ton flotation mill of the Consolidated Smelting & Metals Co. on Chicago Creek treated 12,000 tons of ore from the Black Eagle and Bismark mines, connected with the mill by a 3,300-foot aerial tramway. The sampling works and 75-ton flotation-concentration mill formerly operated by the Clear Creek Gilpin Co. were acquired early in 1936 by the Humboldt Consolidated Mining Co., which discontinued the buying of ores and concentrates about March 15, 1936, and used the mill thereafter chiefly for treating company ores from its Lord Byron group. The Mattie amalgamation-flotation and gravity-concentration mill was operated at the rate of about 20 tons a day during most of the year on ore from the Mattie group. The 25-ton flotation-concentration custom mill of the Ruth Co. at Idaho Springs treated ores from various mines in the district on the basis of a specified charge per ton. The 150-ton flotation mill built at the Bruce mine in 1935 was operated during January, February, and part of March 1936, but not at full capacity. The Gold Center mill at Idaho Springs was run part of the year on ore from the American Girl mine in Gilpin County. Other producing mines included the Belgian Hare, Bride, Cardigan, Castleton, Dixie No. 4, Dona Juanita-Maud Monroe, East Lake (dump), Gem, Kangaroo, Kitty Clyde, Lincoln (upper levels), North American group, Old Settler, P. T., Red Jacket, Shafter, Stephens Placer (Big Chief tunnel), Three Brothers, Two Brothers, and Victor.

Montana district (*Lawson, Dumont*).—Producers of a car or more of ore in the Montana district in 1936 were the American Sisters (dump), DeCapriva (Climax), and Murray properties. Smaller lots were shipped from the Central American, Gold Trust, Hopeville, and Red Elephant. The Dumont mill was used by C. B. Myers to treat miscellaneous lots of custom ore from January to May, when the flotation-concentration section was leased to the Phoenix Trail Mining Co. and was operated continuously from August 8 to the end of the year on ore trucked from the Phoenix mine in the Trail Creek district.

Trail Creek district.—The substantial gain in production of gold in the Trail Creek district in 1936 over 1935 was due largely to increased output from the Phoenix mine, operated continuously throughout 1936. Lessees at the Freeland group continued mining on a small scale; most of the ore produced was treated in the 45-ton flotation-gravity concentration mill at the mouth of the drainage tunnel near Dumont. Ore was shipped to the Leadville smelter, Golden Cycle mill, and Ruth mill from the Donaldson (Wheatland)-Little Champion group, Great Western, Lone Tree, and Turner mines, and a 1-ton lot of ore was sold to the sampler from a prospect in the district.

COSTILLA COUNTY

Grayback district.—Sluicing operations at the Last Chance No. 3, Drum Estate placer, and one other placer in Grayback Gulch yielded 13.20 fine ounces of gold in 1936.

CUSTER COUNTY

Hardscrabble district (*Westcliffe, Silver Cliff*).—Ore was shipped to the Leadville smelter from the Deceiver, Kline, and Passiflora mines and two prospects in the Hardscrabble district in 1936. Lessees

shipped 230 tons of ore from the Nemaha and William dump to the Golden Cycle mill.

Rosita Hills district.—The output from the Rosita Hills district in 1936 was 191 tons of gold-silver ore shipped to the Golden Cycle mill from the Bassick and Margaret-Mary dumps and 111 tons of lead-silver ore shipped to the Leadville smelter from other properties.

DOLORES COUNTY

Lone Cone district (Dunton).—No production of metals has been recorded from the Lone Cone district since 1930, but in 1936 the Modern Gold Mines, Inc., cleaned out and retimbered mine workings and erected a 120-ton flotation mill at the old Emma mine, a former producer of gold-silver ore. Testing of the mill on stope fillings was begun in December.

Pioneer district (Rico).—Ore produced from mines in the Pioneer district in 1936 was zinc-lead-copper-silver-gold ore, and all was sold to custom milling plants or smelters at Midvale and Tooele, Utah. Producers were the Mines Leasing Syndicate from the Burns mine, Hicks Lease on the Rico Townsite, and the Pro Patria group of the Rico Enterprise Mining Co.

DOUGLAS COUNTY

Miscellaneous sluicing and panning operations in Newlin and Lemon Gulches and on Cherry Creek near Parker and Franktown yielded small lots of placer gold in 1936. The Cook Mining Co. reported development work at its lode prospect 1 mile north of Palmer Lake.

EAGLE COUNTY

Burns and McCoy district.—Prospectors recovered small lots of placer gold in 1936 by panning and sluicing at a placer on the Colorado River 5 miles west of McCoy.

Red Cliff district (Battle Mountain).—The Eagle mine group of the Empire Zinc Co. (New Jersey Zinc Co.) was the largest producer of silver and copper in Colorado in 1936, as for several preceding years, and was an important producer of gold from copper-iron-silver-gold sulphide ore shipped to smelters at Garfield and Murray, Utah. The company 600-ton flotation mill, built underground in Eagle Canyon below Gilman in 1929 and operated on ore from zinc-lead ore bodies of the Eagle mine group to December 1, 1931, remained idle in 1936. Other producers, principally of gold ore shipped to smelters or the Golden Cycle mill from ore bodies in the Cambrian quartzite formation on Battle Mountain, included the Alpine, Ben Butler, Black Tiger, Ground Hog, Pine Martin, Star of the West, Tiptop, and Zang, or Emma Tunnel group.

EL PASO COUNTY

GOLDEN CYCLE MILL

Operating continuously in 1936, the Golden Cycle custom mill at Colorado Springs treated 494,566 tons of gold-[silver]-sulphotelluride ores from the Cripple Creek district and 47,443 tons of miscellaneous gold and gold-silver ores and concentrates, mostly from Boulder, Clear

Creek, Gilpin, Lake, and Park Counties, with occasional lots from other districts in Colorado, New Mexico, South Dakota, and Wyoming. The plant includes a sampling mill, secondary crushing unit, 450-ton flotation mill, 1,200-ton roasting section, fine grinding-amalgamation [3]-classification section, sand and slime cyanide plant, and precipitation and refining department. Ores purchased vary in character and grade and therefore are not all treated by the same methods. Gold ores of average grade, comprising principally Cripple Creek ores, are roasted, amalgamated, and cyanided. Low-grade Cripple Creek ores and nearly all miscellaneous ores are concentrated. Iron concentrates produced are mixed with the average grade gold ores and travel with them through the roasting and other processes. The tailings from the flotation mill are cyanided. Some of the miscellaneous ores contain appreciable quantities of copper, lead, and zinc in addition to gold and silver. These are treated by selective flotation, yielding lead-copper-gold-silver-[zinc] concentrates which are shipped to the Leadville smelter.

FREMONT COUNTY

The Webb flotation-concentration mill was completed at the Florence dump of the Bee Zee Metallic Corporation early in 1936 and was operated for several months during the year. As this dump is composed of tailings from mills that treated Cripple Creek ores, the metals recovered are included in the production of Teller County. A prospector sluicing on the Arkansas River recovered a little placer gold.

GILPIN COUNTY

Southern districts (Black Hawk, Central City, Nevadaville, Russell Gulch).—The largest producer of metals (chiefly gold) in Gilpin County in 1936 was the United Gilpin Corporation, which treated by amalgamation and table concentration 287,058 tons of low-grade gold ore from its consolidated group of mines. Most of the ore was mined by the glory-hole system at "The Patch" property on Quartz Hill and was transported 3,250 feet from the mouth of the La Cross tunnel to the mill at Central City by aerial tramway. Ore treated from other company properties was trucked to the mill. The company suspended large-scale milling operations in February 1937, stating that it was unable to find a solution of the problem of tailings disposal that was satisfactory to the farmers of Clear Creek Valley.

At Blackhawk the Gregory-Bates Mining Co. reopened the Bobtail Tunnel, which yielded part of the ore treated at the company mill in 1936. The ore is crushed with stamps, passed over carpet-lined launders, and concentrated on Wilfley tables. The carpet concentrates are amalgamated and the table concentrates are reground in a ball mill and cyanided. The company-leased holdings as of April 3, 1937, comprised the Gregory, Bobtail, Fisk, Cook, and Mammouth (formerly the "Fifty" gold mines group), and Packard Mammouth; the company owns the Mammouth 366a and the Mammouth 371. The company leases on the Hunter-Bates, Becker-Bates, Gaston, Hartford, and O'Neil mines were given up. The 275-ton Pittsburg mill of the Russell Gulch Mining Co. treated 28,375 tons of mine and dump ore by gravity concentration from January to May. The War Dance 10-stamp mill between Central City and Blackhawk was

[3] Free gold saved on lightweight canton flannel blankets and amalgamated in iron arrastre.

operated most of the year on company and custom ores. The Colorado Silver Mines, Inc., erected a 100-ton flotation mill near the portal of the Black Jack shaft, which connects with the Wheeler tunnel level at a depth of about 300 feet. Operation of the mill early in 1937 on ore from the Wheeler vein was planned. Ore mined by the company in 1936 was concentrated at the War Dance mill. The Willis Gulch Mining Co. operated its 50-ton flotation mill intermittently on ore from the Anchor mine and Saratoga dump. Gold-silver-lead ore from the American Girl mine on the Queen Mineral ranch was trucked to Idaho Springs (Clear Creek County) and treated by flotation concentration in the Gold Center mill. The Gilpin Eureka Consolidated Mines, Inc., made test runs of its 65-ton selective flotation mill in November and produced 61 tons of lead concentrates and 17 tons of zinc concentrates; the latter were shipped to the zinc smelter at Amarillo, Tex. Mine and dump ore was shipped to custom plants outside the county, chiefly to the Golden Cycle mill and A. V. smelter, from the Atlantic, Champion, Columbus, Corydon-Adeline, Druid, Egyptian, Federal, Frontenac, Golden Dollar, Incidental, Justice, Morning Star, Old Town, Pewabic group, St. Louis No. 2, Troublesome, War Dance, West Notoway, and others.

Operating its traction dry-land dredge on North Clear Creek from April 1 to November 19, the Humphreys Gold Corporation handled 612,144 cubic yards of gravel and was the second largest producer of gold in Gilpin County in 1936. The company, however, moved the equipment out of the county after the final clean-up for the year and does not plan to resume work in Gilpin County in 1937. About 6,000 cubic yards of gravel were handled by a lessee at the Eugene Placers at Blackhawk, operating a dragline and portable screening and washing plant from September 26 to December 4. Lessees at the Missions Mines Co. property in lower Russell Gulch operated a gasoline shovel and sluices intermittently and handled approximately 1,000 yards of gravel. Individuals using sluices and rockers at miscellaneous small placers in the southern districts of Gilpin County recovered 270 ounces of gold in 1936.

Northern districts.—The Gilpin County Gold Mining Corporation completed and placed in operation a 35-ton stamp amalgamation-flotation concentration-mill begun in 1935 at the We Got Em and Cowboy group at the head of Silver Creek. The mill treated 3,840 tons of ore in 1936. From August through December the Dirigo Mining Co. shipped ore to the Golden Cycle mill from its property 7 miles north of Blackhawk. Lessees at the Perigo group treated a few hundred tons of ore from the Gold Dirt dump and War Eagle claim in a small stamp mill. Operating the Newport mine after May 2, C. H. Reser drove 340 feet of drifts and winzes and treated some ore in the 10-stamp mill at the property. Small lots of ore were shipped in 1936 from the Reform, Golden Flint, and other properties in the northern districts of Gilpin County. F. H. Wolfe operated equipment comprising a gasoline power shovel and trommel screen on wheels powered by gasoline motors at placer ground in Lump Gulch during May and June and handled 4,000 cubic yards of gravel. Hydraulicking was done at another placer in Lump Gulch, and scattered small sluicing operations yielded a little gold.

GRAND COUNTY

Placer miners sluicing intermittently on Broncho Creek and Colorado River near Granby and on a tributary of Red Dirt Creek northwest of Kremmling recovered small lots of placer gold in 1936.

GUNNISON COUNTY

Elk Mountain district.—Scattered lots of smelting ore were shipped from mines and prospects in the Elk Mountain district in 1936. Individuals recovered a little gold by sluicing at the Nora Nos. 1 and 2 and another small placer in the district.

Gold Brick district (Ohio).—The Carter mine on Gold Creek was operated continuously and yielded most of the gold produced in Gunnison County in 1936. The ore also contains comparatively small quantities of silver and lead and is treated by amalgamation and flotation- and gravity-concentration in the company mill at the portal of the 8,800-foot adit by which the mine is opened. A 16-ton lot of gold-silver-lead ore was shipped from the Raymond mine to the Midvale (Utah) smelter, and gold was recovered from ore treated by amalgamation in small mills at the Mountain Boy-Golden Wedge and Wayne properties and at a prospect near Ohio.

Taylor Park (Tin Cup) district.—Prospectors and other individuals sluicing and panning at miscellaneous placers in Taylor Park in the summer of 1936 recovered small lots of placer gold.

HINSDALE COUNTY

From January 1 to May 31, 1936, the Gallic-Vulcan Mining Corporation drove 300 feet of development drifts and raises at its property 10 miles west of Lake City. The company reported on March 20, 1937, that it was preparing to place a 50-ton flotation mill on the property. A lessee at the Gladiator property drove 50 feet of tunnel in 1936 and completed installation of a ball mill and flotation machine having a capacity to treat 15 tons of ore daily. The Golden Wonder mine was operated on a small scale.

JEFFERSON COUNTY

Individual sluicing operations along Clear Creek in Jefferson County in 1936 yielded placer gold, the greater part of which was sold in lots of less than 2 ounces to assayers and refiners in Denver; the remainder was sold to the Denver Mint. The traction dry-land dredge of the Humphreys Gold Corporation, which from 1933 to 1935, inclusive, recovered the bulk of the gold and silver produced in Jefferson County, was moved to Gilpin County in November 1935.

LAKE COUNTY

LEADVILLE DISTRICT

One furnace of the A. V. lead bullion-leady copper matte smelter of the American Smelting & Refining Co. was operated continuously as a lead-bullion plant with subsidiary leady-copper matte plant throughout 1936, and a second lead furnace was operated during January and again from August 19 to the end of the year. Receipts of ore and concentrates, all from Colorado mines, totaled 120,776 tons, an increase of 21 percent over 1935.

Most of the ore produced at underground mining operations in the Leadville district in 1936 was smelted direct at the A. V. smelter. However, the quantity of ore that was shipped from dumps far exceeded the quantity that was newly mined. The largest individual production of gold and silver was made from low-grade ore from the Ibex dump shipped to the 400-ton flotation concentration-cyanidation mill of the Leadville Metals Milling Co. for treatment. The mill was operated in each month except February and March; during the last 4 months of the year approximately 11,000 tons per month were treated. About 12 percent of the gold and silver was recovered in bullion and the remainder in concentrates, which contained considerable lead and some copper (shipped to the A. V. smelter). Gold-silver-lead ore mined from the Resurrection-Golden Contact group through the Yak Tunnel by the Zenda Leadville Mining Co. was concentrated as custom ore in the Bryant mill near the portal of the Yak Tunnel. Some of the gold-silver ores of the district were shipped to the Golden Cycle mill at Colorado Springs for treatment, and specimen gold and placer dust and retorts were sold to the Denver Mint. Zinc-lead sulphide ore from the Tucson dump and Yak Tunnel property was shipped to the pigment plant at Coffeyville, Kans., and zinc-lead-gold-silver ore from various properties was sent to the United States Smelting, Refining & Mining Co. custom concentrator at Midvale, Utah. Other principal producing mines and dumps in 1936 were the Adelaide, Belle Placer, Breece, Chippewa, Dolly B, Fanney Rawlins, Fortune, Garbutt, Highland, Ibex group (mine), Lilian, New Monarch, Ollie Reed, St. Louis, Togo, Tribune, Triumph, Valley, and Venir.

The only important producer from placers in the Leadville district in 1936 was the Pan-Due Placer Co., which operated its dry-land dredge at the Starr and American Smelting & Refining Co. placer ground in California Gulch from May 1 to December 2 and handled 140,000 cubic yards of gravel. The apparatus consists of a gasoline power shovel, screening and washing plant, and four Ainlay bowls. Small sluicing operations by individuals in the district yielded some gold.

OTHER DISTRICTS

Granite district.—Operating the Belle of Granite mine under lease from May to December 1936, the Del Oro Mines did 300 feet of development work in the mine and installed mill equipment comprising a crusher, ball mill, amalgamation plates, 4-cell flotation machine, and Wilfley table. About 100 tons of ore were treated in 1936, but the company removed the equipment early in 1937. Placer gold was produced in 1936 at small placers on the Arkansas River in the Lake County part of the Granite district.

Lackawanna Gulch district.—The only output from the Lackawanna Gulch district in 1936 was gold ore shipped from the Eureka mine to the Golden Cycle mill.

St. Kevin-Sugar Loaf district.—Gold-silver ore from the Amity and Dinero mines and gold-silver-lead ore from the Fanchon Placer were shipped to the Leadville smelter. The other output from the district in 1936 was made by the Kokem Brothers Lease.

Tenmile (Climax, Fremont Pass) district.—The Climax Molybdenum Co. mill at Climax on Fremont Pass, 13 miles north of Leadville,

operating at the beginning of 1936 at an average of 4,000 tons a day, increased the daily average to 7,700 tons before the end of the year; the daily average for 365 days was 5,466 tons. Molybdenum sulphide concentrates containing 15,216,806 pounds of elemental molybdenum were produced.

Molybdenum production at the Climax mill in Colorado, 1924–36

	Elemental molybdenum (pounds)		Elemental molybdenum (pounds)
1924 (idle first 7 months; operated last 5 months)[1]	156, 935	1931	2, 644, 399
1925	821, 757	1932	1, 913, 395
1926	1, 057, 367	1933	5, 028, 695
1927	1, 858, 228	1934	8, 378, 683
1928	2, 957, 845	1935	10, 168, 635
1929	3, 529, 295	1936	15, 216, 806
1930	3, 083, 000		

[1] Idle from April 1919 to Aug. 1, 1924.

Tennessee Pass district.—The output from the Tennessee Pass district in 1936 was 30 tons of gold ore shipped from the Jennie June mine.

Twin Lakes district.—The 20-ton amalgamation-gravity concentration mill built by the lessee of the Columbia claim was operated for a short period in 1936. Placer gold was recovered by lessees at the Zaitz and other placers in the Twin Lakes district.

LA PLATA COUNTY

The American Smelting & Refining Co. lead bullion-leady copper matte smelter at Durango, which was closed November 30, 1930, remained idle in 1936.

California (or La Plata) district (Hesperus, La Plata).—The May Day Milling Co. continued production from the May Day mine in 1936; the ore was treated by flotation concentration in the 50-ton mill at the mine. The Gold King group was operated most of 1936 by the trustee in charge. Near the end of the year the property was leased by the Fawn Mining Co., a Canadian corporation. The mine is equipped with a 50-ton mill, which is connected with it by an aerial tramway 8,000 feet long. In 1936 the Pioneer Gold Producers, Inc., purchased a site for a proposed custom mill near the Idaho and May Day mines and did some preliminary clearing of ground and construction work late in the year. A pilot mill at the Idaho group was run intermittently and recovered a small quantity of gold and silver. Small lots of high-grade gold ore were shipped from the Bessie G. property, Betty Jean, Cason, Last Chance, Last Dollar, Lucky Discovery-Lucky Moon-Old Comfort, Stony Creek, and Valley View.

Vallecito district.—A 6-ton lot of gold ore was shipped to the Leadville smelter from the Grizzly King group in 1936.

LARIMER COUNTY

The Little Mary Mason mine in the Masonville district was operated intermittently in 1936. The mine produced gold ore; a hand-sorted high-grade product was shipped to the Golden Cycle mill at Colorado Springs. A small lot of gold-silver ore was shipped from the Dixie claim.

MESA COUNTY

The Missouri Girl Mining Co. shipped 14 tons of copper ore from a property in the Sinbad district to the Garfield (Utah) smelter in 1936. A few ounces of gold were recovered by individuals sluicing along the Gunnison and Colorado Rivers.

MINERAL COUNTY

Creede district.—Shipments of ore to the Leadville smelter from silver mines of the Creede district were continued in 1936, but the output of silver was 15.5 percent less than in 1935. An experimental reduction mill erected to treat ore from the Commodore mine by flotation and cyanidation was operated for a short period and then closed. Producing mines in 1936 were the Amethyst, Commodore, Corsair, Del Monte-Last Chance-New York-Pittsburg group, Eunice, Manitoba-Ontario, Ochre, and Wedge.

MOFFAT COUNTY

Fourmile (or Timberlake) district.—Most of the output of metals from Moffat County in 1936 was gold recovered at placer ground comprising 880 acres about 29 miles north of Craig in secs. 2 and 11, Tps. 9 and 10 N., R. 92 W., sixth principal meridian. The property was worked spasmodically when water was available during May and June by the Gooly Placer Mines (partnership), using a tractor and "tumblebug" scraper to move gravel to sluices. The company then sold the property to the Eldorado Gold Placer Mines, which moved in a gasoline-powered dragline excavator and dry-land dredge. This equipment was operated intermittently from October 1 to November 25. The total gravel handled by the two companies was 9,546 yards. A little gold was recovered by sluicing at the Amazon, Grubstake, Old Faithful, and other small placers in the district.

Lay district.—Small-scale placer operations on Lay Creek north of Lay yielded placer gold in 1936.

MONTEZUMA COUNTY

The output of metals from Montezuma County in 1936 was derived from high-grade gold ore shipped to smelters from the Red Arrow and Outwest mines, adjoining properties in the East Mancos River area, from specimen gold sold to the mint from the Red Arrow, and from a small lot of high-grade gold ore shipped to the Golden Cycle mill from the South Point claim. The Red Arrow mine, discovered in 1933, has attracted much attention because of its yield of nuggets and specimen gold. The Outwest property (formerly called the Omaha Placers) has been prospected since 1935, and a vein yielding high-grade ore similar to that found in the Red Arrow was reported struck in January 1936. The Hesperus Mining Co. did no mining or development at the Doyle group in Rush Basin after the snow slide destroyed its mill February 15, 1936, but plans to resume work June 15, 1937.

MONTROSE COUNTY

La Sal district.—Sluicing operations on Dolores River yielded placer gold in 1936.

Paradox Valley district.—The United States Vanadium Co., which for several years has been purchasing, locating, and developing vanadium properties in the western part of Montrose County, in the old carnotite area distinguished broadly as the Paradox Valley, started one roasting and leaching unit October 15 and another December 1, 1936. This company extracts its own salt in the vicinity. It has built many new roads in the area and a new town called Uravan.

Naturita district.—Miscellaneous small placers along San Miguel River were worked by individuals in 1936, but only 76.40 ounces of gold were recovered compared with 178.49 ounces in 1935.

OURAY COUNTY

Red Mountain district.—The San Juan Metals Corporation shipped in 1936 to the Shenandoah-Dives mill near Silverton 350 tons of gold-silver-copper-lead-[zinc] ore produced during development work at the Treasury Tunnel group. The mine was operated throughout 1936, and 988 feet of development drifts and raises were driven. G. A. Franz did 824 feet of development work at the Laura Dunmore group from March 1 to December 31 and mined 400 tons of ore, which was stored in bins and chutes ready to mill.

Sneffels district.—Interruption of operations of the King Lease, Inc., by the snow slide in February 1936 that destroyed the company mill caused a decrease in output at the Camp Bird mine in 1936 compared with 1935. The mine was shut down from February 24 to March 5 and from May 16 to July 1; the mill was closed from February 24 to May 22. In rebuilding the mill the company did not change its established method of treating the ore, namely, by amalgamation on plates followed by flotation concentration. Except during the shutdown, the mill treated a daily average of 77 tons of ore in 1936. Gold-silver bullion recovered was shipped to the Denver Mint. The concentrates produced were classed as lead-copper with the principal value in gold, but they carried 24.87 ounces of silver for each ounce of gold, and also considerable zinc; the zinc was not saved at the Leadville smelter.

In 1936 Earl A. Alexander reduced and amalgamated by hand 500 pounds of high-grade ore mined from shallow workings of the Governor group and shipped 2 tons of ore to the Leadville smelter. He treated 100 tons from the Trust Ruby dump nearby in the small mill at the Trust Ruby mine, erected in 1934 with salvaged equipment consisting of 10 stamps, 2 amalgamating plates, and a Wilfley table, all run by water supplied by a 600-foot water line. Carrying on development work at the Revenue Tunnel property from January 1 to September 14 the Revenue Development Corporation drove 1,417 feet of tunnel, drifts, and raises.

Uncompahgre district.—G. A. Franz operated his 100-ton selective flotation mill 2 miles north of Ouray at a daily average of 75 tons for 257 days in 1936 on dry silver ore, which he mined through the Syracuse tunnel from his Pony Express-Upper Bachelor group and from the Lower Bachelor group which he operated for the Bachelor Development Co. Silver-lead concentrates shipped to the Leadville smelter from this mill yielded the second largest individual output of silver in Colorado in 1936, considerable lead, and some copper and gold. The McCullough lease operated the American Nettie group, Wanakah group, Jonathan claim, and O & N group as a unit continuously on a

small scale. Gold-silver ore containing some lead and copper was shipped to the Leadville smelter, and gold recovered in a small washing plant at the Wanakah was sold to the mint. A small lot of silver-lead ore was shipped to the Midvale (Utah) smelter from a prospect in the district. Some gold and silver were recovered by the Lucky Irish Mining & Milling Co. while experimenting with the operation of a placer north of Ouray with a dragline and Wilfley tables, and by a prospector sluicing on Uncompahgre River.

PARK COUNTY

Alma Placers district.—Lessees on the Alma Placers recovered approximately two-thirds of the total placer output of Park County in 1936. The larger part of the gold was recovered by operators who sank inclined or vertical shafts to bedrock and drifted, using mechanical equipment to bring the gravel to sluices on the surface.

Beaver Creek district.—A steam shovel and movable washing plant operating on Beaver Creek produced the bulk of the output of metals from the Beaver Creek district in 1936. The remainder was recovered by hydraulicking at the Shelton placer and sluicing at other placers along Beaver Creek.

Buckskin district.—Only 136 tons of ore were shipped from the Buckskin district in 1936, most of which came from the Paris group, Phillips, Red Lion, and Wyandotte-Apex group. Considerable prospecting and development work was done at these and other properties in the district.

Consolidated Montgomery district.—Several cars of gold-silver ore from the Magnolia mine and one car from the Columbia were shipped to the Golden Cycle mill in 1936. A second car from the Columbia and one lot of lead-silver ore from another property were shipped to the Leadville smelter.

Fairplay district.—Placer gold was produced in 1936 by lessees hydraulicking, drift mining, and sluicing at placer ground formerly the property of the South Park Dredging Co. on South Platte River near Fairplay.

Horseshoe district.—No ore was shipped from the Horseshoe district in 1936, but on October 19 the Barcoe Mining Co. let a contract to drive a 2,000-foot exploration tunnel at its property on Sheep Mountain comprising 9 patented claims and 42 unpatented claims in secs. 4, 9, and 10, T. 10 S., R. 78 W., sixth principal meridian. As of March 1, 1937, the tunnel, 5 feet wide by 8 feet high, had been driven 905 feet.

Mosquito district.—The Mosquito district ranked second among Colorado districts in production of gold in each year from 1931 to 1936, inclusive, except in 1932 when it ranked first. Nearly all the output came from ore bodies in the London Fault area on and adjoining London Mountain. Associated with the gold in the ores are appreciable quantities of silver and lead and some copper and zinc; none of the zinc is saved at the Leadville smelter, where most of the district ores and concentrates are sold. In 1936 the largest producers, in order, were: The London Gold Mines Co., operating the South London and London Extension groups, equipped with a 175-ton flotation mill (equipment added in 1936 to raise the capacity, formerly 125 tons); the Fairplay Gold Mines, Inc., operating the "North London" mine and 100-ton flotation mill; the London-Butte Gold Mines Co., which in March placed in operation a new 100-ton flota-

tion mill at its Butte group; W. A. Ellis, Inc., mining and shipping high-grade ore from the American mine; and lessees on the West London mine, who shipped their ore to the smelter.

East of the London Fault area the principal producer was the Hock Hocking mine, yielding silver-lead-gold ore; most of the ore was shipped crude to the Leadville smelter, but after October some was treated in the 50-ton custom mill erected close by during the year by the Alma Milling & Metals Corporation. Some ore was shipped from the Ophir group and Susquehanna claim. A small mill was completed late in 1936 at the Dauser mine, from which several lots of ore had previously been shipped to the Golden Cycle mill at Colorado Springs and the Leadville smelter. Small lots of ore were shipped from other mines and prospects in the Mosquito district in 1936. The Newbonnet Mining Co. carried on development work at the Mascotte Tunnel property. A swinging sluice box driven by an automobile engine was used to recover gold at the Pennsylvania Mountain placer, and small sluicing operations at other placers in the Mosquito district yielded a little gold.

Tarryall district.—The Peerless Mining Co. operated its equipment, comprising a power shovel, trommel screen, four Ainlay bowls, and stacker, on the Wilson placer 7 miles southeast of Como from May 18 to October 24 and recovered most of the metals produced in the Tarryall district in 1936. Individuals sluicing on Tarryall Creek recovered small lots of placer gold. Testing of old river channels by pits and Keystone drills was continued in November and December at the Peabody placer and Foster Cline ranch on Tarryall Creek, under a Class "B" loan of the R. F. C.

PITKIN COUNTY

Avalanche district.—From August 1 to December 15, 1936, lessees operated the Ground Hog-Double Decker-Gypsum group and shipped 8 tons of lead-gold-silver ore to the Leadville smelter.

Roaring Fork district (Aspen).—Operating its 50-ton flotation mill at the portal of the Midnight tunnel the Midnight Mining Co. in 1936 treated 5,000 tons of siliceous silver ore, containing some lead and zinc, extracted from the mine and 3,000 tons taken from the dump at the old Midnight shaft. The bulk of the silver was recovered in lead concentrates sold to the Leadville smelter. Byproduct zinc concentrates containing some silver and lead were produced in the zinc unit and shipped to the zinc smelter at Amarillo, Tex.

Management of the consolidated group of properties leased in 1934 by the Colorado-Duluth Mining Co., comprising the Smuggler Leasing Co. (Durant group), Della S Consolidated Mines Co. group, Percy La Salle Mining & Power Co., and Spar Consolidated Mines Co. groups, reverted to the "Aspen Leases" in April 1936; the former company made application to be dissolved as of April 30. Sublessees on the properties in 1936 shipped 18,692 tons of silver ore containing lead and lime; the lime also was paid for at the Leadville smelter.

RIO GRANDE COUNTY

Summitville district.—The Summitville Consolidated Mines, Inc., operated its Little Annie group of mines and flotation concentration-cyanidation mill continuously in 1936. Although the rated capacity

of the mill at the end of 1936 was 120 tons, the mill treated a daily average of 135 tons for 365 days in the year. The ore is brought by trucks and tramway to the mill, where it is crushed and fed to ball mills in closed circuit with a unit cell, tables, and Dorr classifier. The overflow from the classifier—65 percent minus 200-mesh—goes to Fahrenwald sub-"A" flotation cells. Tailings from the flotation machines are cyanided. Precipitation is by the Merrill-Crowe process. Concentrates produced are shipped to smelters. A small stamp-amalgamation unit was installed in 1936 to treat high-grade ore. Early in 1937 press reports stated that the company purchased the Aztec claim adjoining the Little Annie group and ended an apex suit that had been instituted against it in August 1936 by the owners of the Aztec.

ROUTT COUNTY

Hahns Peak district.—One lot of lead-silver-gold-[zinc] ore was shipped to the Midvale (Utah) smelter from the Elkhorn mine north of Columbine, which was being investigated by the Elkhorn Gold & Silver Mining Corporation in 1936. Sluicing operations at placers in Ways Gulch south of Grouse Mountain and on the north slope of Hahns Peak yielded some gold.

SAGUACHE COUNTY

Crestone district.—The Luis Maria Baca Mining & Development Co., lessee on a group of mines in the mineral section of Baca Grant No. 4, did approximately 1,000 feet of development work in the mine in 1936 and produced 3,657 tons of gold ore, which was treated in the company 35-ton flotation-concentration mill on Cottonwood Creek, half a mile from the mine and 6 miles south of Crestone. Free gold caught on carpets placed ahead of the flotation machine was amalgamated and sold to the mint, and concentrates produced were sold to the Leadville smelter. A 1-ton lot of ore was shipped from a prospect in the district.

Kerber Creek district (Bonanza).—Lessees on the Rawley mine shipped 892 tons of silver-lead-copper ore to smelters in 1936. Similar ore was shipped from the Jupiter and Whale claims, both small producers in 1936, and one lot of lead-silver ore was shipped from the Baltimore claim.

Music district.—Development work was done at the Golden Treasure group for 4 weeks in July and August 1936, and a small shipment of gold-silver-lead-copper ore was made to the Leadville smelter.

SAN JUAN COUNTY

Animas district.—The Shenandoah-Dives Mining Co. operated its 600-ton selective flotation mill near Silverton continuously in 1936. The larger part of the mill feed was gold-silver ore containing copper and lead from the company-owned and company-operated Mayflower group, which is connected with the mill by a 1½-mile aerial tram suspended across the Animas River Valley high over the Animas River. From the beginning of its operations in 1928 through 1934 the company treated only ore from its own properties, but in 1935 it began to accept custom ores from a few neighboring mines for concentration, and in 1936 the company installed sampling equipment and offered its milling facilities to a larger number of operators. Mines supplying

most of the custom ores, in order, were: Pride of the West, North Star-Sultan, Green Mountain, Vertex, Little Fannie-Philadelphia group, Treasury Tunnel (Ouray County), Coming Wonder, and King. Besides carrying on its mining and milling operations, the Shenandoah-Dives Mining Co. contracted with the American Smelting & Refining Co. to drive a 3,000-foot crosscut from the main haulage adit of the Shenandoah-Dives property to the Silver Lake group, owned by the American Smelting & Refining Co.

At the Old Hundred property, the Old Hundred Gold Mining Co. in January, February, and March, 1936, drove 700 feet of drifts and raises and constructed a 1,500-foot aerial tramway from the mine to the mill in Cunningham Gulch. Other work done included repairing the mill building, installing a new crusher, and providing facilities for tailing disposal. The mill was operated 60 days and treated 5,590 tons of ore taken out in development operations. The mine was closed March 22, 1936. Other producers in the Animas district included the Champion group, Bill Young, Mabel, Peerless, and Queen City. A little placer gold was recovered by sluicing at the Iron Magnet mill site.

Eureka district.—Producing mines in the Eureka district in 1936 were the Brooklyn group, operated continuously, and the Robert Bonner group, operated from July 15 to November 15. The Sunnyside mine, which was equipped with a 1,000-ton selective flotation mill and was an important producer of gold, silver, copper, lead, and zinc before it was shut down on September 30, 1930, remained idle in 1936.

Ice Lake Basin district.—Two lessees working at the Bandora group from May 25 to November 15, 1936, shipped 137 tons of gold-silver-lead ore to the Leadville smelter.

SAN MIGUEL COUNTY

Iron Springs district (Ophir).—Only small tonnages of ore mined in 1936 were shipped to smelters from the Iron Springs district; but due to increased metal prices late in 1936 a sizable tonnage of low-grade middlings, containing chiefly silver and lead but also some gold and copper and formerly stacked at the old Carbonero mill, was shipped to smelters in Colorado and Utah. At the Butterfly-Terrible group 285 feet of development work were done in the mine, and one lot of ore was shipped to the Leadville smelter. The mill was repaired and made ready for operation, which is planned for 1937. Other producers in 1936 included the Carribeau, Gold Bar, Montezuma, New Dominion, and Silver Bell.

Lower San Miguel district (Sawpit, Vanadium).—A few lots of gold-silver-lead ore were shipped to smelters from the Lizzie and J. L. lode properties in 1936, and some gold was recovered at small placers along the San Miguel River and its tributaries.

Mount Wilson district.—The Polar and Silver Pick mines were operated on a small scale during part of 1936, and each yielded small lots of high-grade gold ore, all of which was sold to smelters.

Upper San Miguel district.—The Smuggler Union group was operated continuously in 1936 and again yielded the bulk of the output of gold, silver, and lead from San Miguel County. The ore was treated by amalgamation followed by gravity and flotation concentration in the 300-ton mill connected with the mine by a 3,000-foot aerial tram-

way. On December 15, the Veta Mines, Inc., acquired operating control of the property and proposes to explore geologically selected zones extending to the sedimentary formations approximately 700 feet below the present workings. The San Juan Metals Corporation, in its fourth season of operating its 400-ton flotation-gravity concentration mill on old tailings 1 mile east of Telluride, was active from May 12 to October 20, inclusive, and treated 22,405 tons yielding gold-silver-lead copper concentrates which were shipped to the Leadville (Colo.) and Garfield (Utah) smelters. The 50-ton amalgamation-gravity concentration mill erected in 1935 at the Mammoth group was crushed by a snow slide in February 1936 and was not rebuilt during the year. Construction work on a 150-ton flotation-concentration mill at the Alta-St. Louis group was begun in the latter part of 1936. A clean-up at the site of the old Alta mill that burned down yielded 35 tons of gold-silver-lead ore which was shipped to the Leadville smelter. Other producers in the Upper San Miguel district in 1936 included the Cimarron dump, Grace, Lucky Strike (small milling operation on old tailings), Laura (equipped with a 15-ton amalgamation-gravity concentration mill), Royal, and Savage. Sluicing along the San Miguel River below Telluride yielded small lots of placer gold.

SUMMIT COUNTY

Breckenridge district.—The Continental Dredging Co. operated its electrically driven floating dredge on Blue River intermittently for 238 days in 1936 and handled 622,400 yards of gravel. The dredge has a capacity of 4,000 cubic yards per 24 hours and is equipped with 88 buckets, each of 7½-cubic-feet capacity. The Tiger Placers Co. dredge at Breckenridge was idle throughout 1936. A power shovel, trommel screen, and sluices were operated from May 20 to August 10 at the Bemrose-Bostwick placer in Hoosier Gulch, and similar equipment was used by Miller & Nelson in French Gulch. Hydraulicking and drift mining at placers on French Gulch and sluicing operations on Blue and Swan Rivers, Georgia Gulch, and Farncomb Hill yielded gold.

Zinc-lead ore was shipped in 1936 from the Royal Tiger property to the custom concentrator of the United States Smelting, Refining & Mining Co. at Midvale, Utah. A 50-ton gravity-concentration mill equipped with a 4- by 4-foot ball mill, a rag table, a two-compartment Hartz jig, and three No. 6 Wilfley tables was built 5 miles east of Breckenridge to treat ore from the Carbonate mine, from which a 3,000-foot aerial tramway was constructed to transport the ore from the mine to the mill. The mill was operated for only 7 days in 1936, when snow and cold weather closed the mine. Ore was shipped to the Leadville smelter from the Arctic, Bemrose-Bostwick (producer from both lode and placer operations), Blue Flag, Blue Jay, Briar Rose, Dunkin, Fredonia, Jumbo, Mountain Mary-Frigidare, Ohio, and two other properties.

Montezuma district.—In 1936 ore was shipped from the Bullion, Burke group, Florado-Sts. John group, and Silver King mine to the Leadville smelter. The Florado Mining Co. shipped a car of zinc-lead ore to the custom concentrator at Midvale, Utah.

Ten Mile (Kokomo, Robinson) district.—Producing mines in the Ten Mile district in 1936 were the Connors Bonanza, Delaware, Gold Crest, Kokomo, and Payrock. The Wilfley mill at Kokomo was

operated for a short period on ore from the Delaware. The ore shipped from the Payrock was concentrated in the Bryant custom mill near Leadville. A portable screening and washing plant fed by a Diesel power shovel was installed late in 1936 at the McNulty placer on McNulty Gulch where the gulch enters the Ten Mile River Valley. The plant was operated for a short period before the season closed, but the gold recovered was not sold in 1936.

Wilkinson district.—Two prospectors placering in the Wilkinson district recovered a little gold in 1936.

TELLER COUNTY

CRIPPLE CREEK DISTRICT

The output of the Cripple Creek district in 1936 was 607,690 tons of mine and dump siliceous sulphotelluride gold ore yielding, in recovered metals, 141,456.46 fine ounces of gold and 16,541 fine ounces of silver, compared with 460,448 tons yielding 124,287.66 ounces of gold and 13,287 ounces of silver in 1935. In addition, placer dust and specimen gold originating in the district and sold to assayers, refiners, and the mint in 1936 by operators, specimen collectors, and others aggregated 151.74 fine ounces.

The Golden Cycle mill at Colorado Springs (operations described under El Paso County) purchased 494,566 tons (81.4 percent) of the district output of ore in 1936. The mill is owned and operated by the Golden Cycle Corporation, which also owns several mines in the district and the Midland Terminal Ry., which transports virtually all the ore received at the mill from the Cripple Creek district. Treatment rates in effect in 1935 at the Golden Cycle mill were given in Minerals Yearbook, 1936 (pp. 271–272). The same rates for treating the ore were continued in 1936, but in October the company, seeking to improve the grade of ore offered, instituted a new system for gold payments, under which it raised the price paid for gold in ore carrying a high gold content and lowered it for ore carrying 0.18 ounce of gold and under per ton.

The Cripple Creek Milling Co. purchased under contract all the ore produced from mines and dumps owned by the Stratton-Cripple Creek Mining & Development Co. (Stratton Estate) for treatment in its 500-ton flotation-roast-cyanidation mill on Globe Hill. The company also purchased on open schedule part of the production of various independent operators in the district. Operated at reduced capacity throughout 1936, the mill treated 92,424 tons of ore. In January 1937 it was shut down and up to the time this report was written (May 25, 1937) was still idle.

MINES REVIEW

The total number of producing mines, dumps, and prospects in the Cripple Creek district in 1936 was 122, including each of several separately operated mines under one general management. Production was made from mined ore at 91 mines and prospects. The three largest producing companies, in order of metal output, were the United Gold Mines Co., an operating and holding company for property scattered throughout the Cripple Creek district; the Cresson Consolidated Gold Mining & Milling Co.; and the Golden Cycle Corporation-Ajax Operations (formerly the Granite group).

The annual report of the United Gold Mines Co. for the 10 months ended October 31, 1936 (dated Dec. 20, 1936), contains the following report of the mine superintendent.

Axtel.—L. W. Reiter of Denver, who has a lease on the Axtel, is working through the Solomon shaft and is preparing to sink the shaft, starting January 1, 1937. He expects to sink an additional 100 feet. One set of split-check sublessees is operating and making a small production of low-grade ore.

Both the Fairview and Londonderry have been idle during the entire year.

The Patti Rosa has been extensively developed during the past year by the Tennessee Mines, Inc., and they have discovered a large body of medium-grade ore, and they are making a production of about one railroad carload per day. They haven't yet determined the length and width of the ore shoot.

Bonanza.—The Bonanza is under lease to the Golden Cycle Corporation, and this company has driven a crosscut to the Bonanza vein and drifted on the vein for a distance of about 100 feet. An ore shoot of very good grade about 30 feet long has been opened, and no doubt when this is developed it will be a source of production for the year 1937.

Coriolanus.—Very little work was done on this property during 1936.

Deadwood.—The Deadwood and Trachyte are being operated by the Gold Bullion Mines, Inc. This company has conducted an active campaign of development and has opened many ore shoots which will make the property very productive during the coming year.

Findley and Shurtloff.—The larger part of these properties is under lease to the Golden Conqueror Mines, Inc., and they have recently discovered a new ore shoot on the 10th level of the Burns shaft on Shurtloff ground. The vein is in virgin ground, is of medium-grade ore, and has been opened for a distance of about 100 feet. As the ore is wider than the drift, the width has not yet been determined, but a cut-out has been started, and after chutes have been built the walls will be prospected to determine the width. Both breasts of the drift contain good ore.

This is one of the most important developments of the year on the United Gold Mines Co.'s properties.

Hardwood.—Stocklacey and associates are operating on the north end of this property and have made a small production of low-grade ore.

Hull City.—The lease of the Hidalgo Gold Mines, Inc., was purchased by the United Gold Mines Co., and the property is now being operated on company account.

May B.—No work of any consequence was done on this property during the year.

Portland.—The result of operations for the year 1936 on the Portland group has been fairly satisfactory. The group includes the Last Dollar, Portland No. 1 and 2 shafts, operated by the company with the lessees working on split check, and the Independence, Colorado City, Portland No. 3, Ocean Wave, and a number of shallow shafts and surface workings which are leased to independent lessees.

The production from dumps for the first 5 months of the year averaged about one railroad car a day, but has steadily decreased since then until at present it is about 10 cars a month.

Operations at the Portland No. 1 and Last Dollar shafts have shown a substantial operating gain during the year, and Portland No. 2 operations have shown a small operating gain.

The lessees working the outlying properties have produced a considerable tonnage of ore, some of which has been of excellent grade. Portland No. 3, operated by Community Gold Group No. 1, Inc., has produced a number of shipments which ran between 1.00 and 2.00 ounces per ton. The Colorado City shaft, operated by Colorado Gold, Inc., produced a steady tonnage of medium grade throughout the year. The Independence, under lease to Newstrom & Co., in the year ended November 1, 1936, produced a total of 138 carloads of ore with a gross value of $23,439. A number of shallow workings, both through shafts and in open-cuts, have produced some fairly good ore as well as a fair tonnage of low-grade ore. The royalties from these operations add to the income of the company.

At the Last Dollar, an excellent grade of ore has been obtained from workings on the Hawkeye flat vein, some shipments having settled at a value of better than 4.00 ounces, or over $120 per ton. A large tonnage from the syenite vein stopes was shipped from the 500- and 600-foot levels of the same mine. The average value of this last ore is between $6.00 and $7.00, but it is cheaply mined and can be handled at a small profit.

The profitable production at Portland No. 1 came from ore developed on the Diamond and Independence veins on the 400- and 500-foot levels and from the

"breccia vein" and Bobtail vein on the 600-foot level. All of the above ore was of excellent grade. It is interesting to note that all of it came from areas which were supposedly worked out. Inasmuch as this ore has been found in old stoped areas which have settled and show considerable crushing at some points, the mining of the ore has been difficult and slow.

Other operations have produced some tonnage from No. 1 shaft, notably a lessee operation on the 600-foot level. Ore pulled from the caved No. 2 Portland stope has run 1 ounce per ton consistently, after screening. A production of a car of screenings and several cars of coarse ore (low grade) has been made from this lease each month.

The only profitable production from No. 2 Portland shaft has been from lessee's operations on the vein above 1,700, situated north and east of No. 2 shaft. A number of good shipments have been made from small stopes 50 feet or more above the 1,700-foot level. One shipment of screenings ran 3.62 ounces, or over $100.00 per ton. Several others ran more than 2 ounces per ton.

Ore from a stope on the Wisconsin vein on 1,700, from the "breccia vein" on 700 and 800, returned little or no profit. The Wisconsin operation has been abandoned since. The low grade from the "breccia vein" was largely mined in prospecting work.

During the summer and fall a considerable amount of work was done on the Portland surface plant to improve it and lessen the fire hazard.

The old store-room building, engine room at No. 1, boiler room at No. 1, shaft-house building, and several old ore bins which were no longer in use, were wrecked. Several other small buildings were built or remodeled to make them nearly fireproof.

The headframe and first 30 feet of No. 1 shaft were in very poor condition and were repaired. The shaft was lined with concrete from surface down to bedrock, so that it is permanently repaired this far down.

The Portland compressor plant was in a very poor location at No. 2 shaft. It was difficult to get supplies in and make repairs. The building has been in danger of being covered up by tailings from the old mill on top of the hill, and sand blowing around during windstorms has caused unnecessary wear on the equipment.

Consequently, a new completely fireproof compressor plant has been established at No. 1 shaft, and is now in operation. The building is constructed of cinder blocks and equipped with a steel truss roof and steel doors and windows. The compressors are equipped with air filters now, and this should add materially to their life.

The unused buildings at No. 2 shaft are also being torn down, 22 sets of lessees are working through company-operated shafts, 5 sets through the Independence, and 14 sets are working elsewhere on the property exclusive of dump lessees.

Rose Nicol.—The company is operating on the 8th level of the Rose Nicol mine, and is making quite a large production of low-grade ore.

A raise from the 17th to the 14th level of the Cresson mine was completed, and in this raise they have four sublevels, all of which are producing a good grade of ore from Trail ground. This has been the best source of production for the United Gold Mines Co. during the past year, and Mr. William Petrie deserves much credit for this work.

Vindicator and Theresa.—The Theresa has been operated exclusively by split-check lessees, and during the year the United Gold Mines Co. has received a nice profit from this operation, and the mine looks quite promising for the coming year.

Since the first of the year 1936 the Vindicator has conducted a campaign of development on the 21st level. Pumps to take care of 1,500 gallons of water per minute were installed in January 1936, and since that time about 1,200 feet of drifting and crosscutting has been done on company account.

The La Bella vein was encountered and an ore shoot opened for a distance of 135 feet. This was stoped out on company account, but, due to the fact that the ore was very low grade, this was not a profitable operation. Since that time the level has been turned over to split-check lessees and an ore shoot on the Lilly vein between 2,100 and 2,000 has been discovered, which is being worked profitably by Wade & Co.

Miles Fleetwood and associates have opened an ore shoot on what is presumed to be the Carr vein for a distance of about 125 feet, and they have values in both the north and south breasts. This has all indications of being a profitable operation for both the company and the lessees. In fact, there is, from all appearances, a bright prospect for the Vindicator for 1937.

Total production of property—United Gold Mines Co.

	Net tons	Gross value
Ore mined before consolidation	26,310	$456,806.19
Production under operation of the United Gold Mines Co.	1,460,651	16,003,593.90
Total to Dec. 31, 1936 [1]	1,486,961	16,460,400.09

[1] Company report covers total production to Oct. 31, 1936. Figures for November and December added by the staff of the Bureau of Mines from information furnished by the United Gold Mines Co.

Production of the United Gold Mines Co.—Company ore in 1936 [1]

Mine	Net tons	Gross value	Company ore cash receipts	Average gross value per ton	Number of cars shipped
Vindicator	13,058	$60,374.16	$21,902.44	$4.62	393
Rose Nicol	5,578	112,832.09	76,114.59	20.23	214
Hull City	1,173	4,997.05	1,453.27	4.26	39
Portland	859	3,963.85	1,661.80	4.61	16
Theresa	137	262.46		1.91	4
	20,805	182,429.61	101,132.10	8.77	666

[1] Published report covers 10 months only. Figures for November and December added by the staff of the Bureau of Mines from information furnished by the United Gold Mines Co.

Production of the United Gold Mines Co.—Lessee ore in 1936 [1]

Group	Net tons	Gross value	Royalties received	Lessees' receipts	Average gross value per ton	Number of cars
Vindicator	26,338	$216,316.37	$56,986.17	$64,438.57	$8.21	780
Theresa	15,049	167,550.96	44,826.94	56,227.58	11.13	464
Rose Nicol	8,892	69,482.59	9,394.35	25,046.61	7.81	277
Hull City	3,774	21,322.69	3,978.48	4,424.49	5.65	126
Portland	23,867	244,076.56	54,431.22	85,421.05	10.23	809
Last Dollar	20,643	168,468.21	43,658.86	48,668.77	8.16	582
Deadwood group	14,238	142,793.85	13,870.68	62,903.90	10.03	438
Londonderry group	1,619	16,513.70	1,505.21	7,419.07	10.20	52
Hardwood group	6,656	73,664.24	5,689.74	33,353.22	11.07	194
Empire group	4,476	14,980.03	288.52	6,307.86	3.35	65
W. P. H. group	2,169	9,055.03	521.33	1,839.02	4.17	46
Bonanza group	2,452	59,408.01	8,032.66	32,322.18	24.23	74
	130,173	1,203,632.24	243,184.16	428,372.32	9.25	3,907

[1] Published report covers 10 months only. Figures for November and December added by the staff of the Bureau of Mines from information furnished by the United Gold Mines Co.

The annual report of the Cresson Consolidated Gold Mining & Milling Co. for the 12 months ended December 31, 1936 (dated February 15, 1937), says:

During the 12 months 61,563 dry tons of ore were shipped on company account of a gross value of $465,411.88, averaging $7.56 per ton; the returns, less transportation and treatment of $219,901.86, were $245,510.02, giving the ore a net value of $3.99 per ton. The company received as additional income the sum of $1,123.54 interest on bank deposits and notes, and $192,956.18 net royalty on 58,215 tons lessee ore, in addition to $1,541.67 dividend from the Elkton Co., making a total of $441,131.41, with total expenses of $342,104.21, resulting in a net gain from operations of $99,027.20.

During the past year the development on your property has been encouraging. On the upper levels some large low-grade stopes were opened and small chutes of better ore.

The water was pumped from the eighteenth level. New work on this level has opened 100 linear feet of ore which is above average grade and gives promise of having considerable width. In places it is now 12 feet wide and ore in both

walls. Other development on this level is being pushed. The water has fallen off in volume pumped.

The Dante and Gold Sovereign claims were operated by lessees, who shipped a large tonnage of low-grade ore.

Development

	Feet	Feet
Drifts and crosscuts:		
Company	4, 503	
Lessees	4, 087	
		8, 590
Raises and winzes:		
Company	741	
Lessees	1, 936	
		2, 677
Total		11, 267

The 18th level, the first level below the Roosevelt Tunnel, was unwatered in September 1936. This level had not been worked since June 1929. Before any development work could be undertaken, a large amount of retimbering and clean-up work was necessary to reach all parts of this level, which was found to be in very bad condition. This work is still being carried on.

The most encouraging development on the property, at the present time, is the 18th level development work, since the level was unwatered, which has resulted in the opening of two bodies of medium-grade ore. Work has not progressed far enough at this time to estimate their tonnage or value, but they look very encouraging.

Development of the upper levels has opened small bodies of ore on the 17th, 14th, 13th, 12th, and 9th levels. A small ore body of very good grade has been opened between the 12th and 13th levels.

Twenty-six sets of split-check lessees are at present working through the Cresson shaft, most of whom are producing some ore. In addition, the Dante and Gold Sovereign shafts are under lease on a graded royalty basis. Both these lessees have done considerable development work and shipped a large tonnage of low-grade ore.

At the present time, the most favorable outlook for new ore seems to be on the deeper levels.

The average cost per ton shipped by company and lessees during 1936 was $2.85, on a total of 119,779 tons.

	Per ton
Federal taxes	$0. 161
State and county taxes	. 105
Insurance	. 086
Salaries of officers	. 050
Colorado Springs office	. 028
Mining operations	2. 315
Pumping	. 078
General	. 027
	2. 85

Production of the Cresson Consolidated Gold Mining & Milling Co., Colorado, 1903 to Dec. 31, 1936

Period	Dry short tons	Gross value	Freight and treatment	Net value
1903 to Dec. 31, 1935	2,350,979	$37,776,158.81	$11,811,172.30	[1] $25,964,986.51
1936:				
Company ore	61,563	465,411.88	219,901.86	245,510.02
Lessee ore	58,215	663,831.65	251,851.91	411,979.74
1903 to Dec. 31, 1936	2,470,757	38,905,402.34	12,282,926.07	26,622,476.27

Period	Royalties received by company	Amount paid lessees	Average gross value per ton	Average net value per ton	Dividends
1903 to Dec. 31, 1935			$16.06	$11.04	$12,857,072.50
1936:					
Company ore			7.56	3.99	
Lessee ore	$192,956.18	$219,023.56	11.40	7.08	109,800.00
1903 to Dec. 31, 1936			15.75	10.78	[2] 12,966,872.50

[1] The company annual report for 1935 gave $25,952,895.85, which was corrected by letter from the company dated July 23, 1936, to read $25,964,986.51.
[2] Represents 33.33 percent of the gross value and 48.71 percent of the net value.

The annual report of the Golden Cycle Corporation dated March 10, 1937, for the calendar year ended December 31, 1936, contains the following paragraphs regarding the corporation's mining operations in the Cripple Creek district.

The shaft on the Ajax has been sunk from the 21st level to the 24th level, 375 feet, and is now being continued to a depth of 500 feet below the 21st level, where a pump station will be made. From this station a crosscut will be made to cut the Mohican, New Market and Little Montana veins. The Mohican has been disappointing on the 22nd and 23rd levels, but New Market has higher values on 23rd than on 21st level. The cost of sinking was increased by a large flow of water, and the mine showed only $12,958.46 net gain for 1936, after depreciation and depletion. However, there is a large amount of developed ore which is being mined and shipped, and we hope 1937 will show a substantial profit.

The Anchoria-Leland has shown a gain for 1936 of $10,154.81 net, after depreciation and depletion, and on the 300 level has opened an ore shoot of good value 225 feet long. Also one lessee has a large stope of low-grade ore.

Data for the following table were taken from the annual reports for 1936 issued by the three companies named.

Production in 1936

Company	Net tons	Gross value	Royalty	Lessees	Average gross value per ton
Dr. Jack Pot Mining Co	14,317	$70,356.84	$4,287.12	$19,700.48	$4.91
Empire Lee Mining Co	21,453	121,055.47	7,556.55	42,758.71	5.64
The New Gold Dollar Mining Co	3,872	29,457.27	2,200.01	11,094.26	7.61

Nearly all the output from the Stratton Estate was made by companies and individuals that leased the various mines under the royalty system and conducted their own operations, either mining on company account or subleasing to split-check lessees.[4] The largest pro-

[4] Under a split-check lease, the operating company furnishes the hoisting power, explosives, timber, and all other supplies and the lessee provides the labor; the net proceeds from the mill (not including royalty) are divided equally between the two.

ducers of gold, in order, were the Logan mine, Orpha May, Geneva, Moon Anchor, American Eagles, Specimen, and Los Angeles. Among other producers were the Abe Lincoln mine, Block 98, Longfellow, Porcupine, and War Eagle. The total development work done at all properties on the Stratton Estate during 1936 was 14,311 feet, of which 10,779 feet were done by the two largest producing companies—the International Gold Producers, Inc., and the Orpha May Mining Co. After the closing of the Cripple Creek mill in January 1937 ores from the Stratton properties were again shipped to the Golden Cycle mill at Colorado Springs.

The Cameron Gold Mines, Inc., continued production from the Cameron Townsite and Pinnacle group throughout 1936. Development work done comprised 100 feet of sinking on the main Cameron shaft and 1,456 feet of drifts and crosscuts. The Hidalgo Gold Mines, Inc., shipped ore continuously from the El Paso group, in which it has the controlling interest, and the Victor mine (Smith-Moffat Mines Co.) operated under lease. Approximately 3,000 feet of drifts and crosscuts were driven at the El Paso group. Lessees operated the Elkton group continuously. The Elkton Co. acquired the property of the Raven & Beacon Hill Gold Mining Co. in Arequa Gulch, comprising about 21 acres adjoining the Elkton property. W. D. Wade & Co. shipped a large tonnage of dump ore from the Empire Lee property. Thomas Kavanaugh operated his cyanide leaching plant at the Iron Clad mine continuously. The Blue Moxie Gold Mining Co. reopened the Blue Bird mine, beginning development work in the mine July 10 and shipments of ore later in the year. The Winfield Mining Co. operated the Queen group most of the year and shipped the ore produced to the Cripple Creek mill. The Joe Dandy Mining Co. repaired the shaft and buildings and started development work at the Joe Dandy mine, from which lessees shipped ore during part of the year.

Among other producers in the Cripple Creek district in 1936 were the Acacia Gold Mining Co. (Morning Star and North and South Burns), Amanda, Atlas Gold Mines Co. (Midget-Bonanza King), Black Belle, Caledonia, Commonwealth Gold, Inc., Delmonico, Economic mill dump, Forest Queen, Free Coinage Gold Mining Co., Friday, Golden Conqueror Mines, Inc., Hiawatha, Index group, Jerry Johnson, LeClair Consolidated Mines Co. (Mary McKinney), Ramona, Reba Lee Mining Co. (Mohawk), Requa Savage group, Rigi group, Rubie, Sangre de Cristo Tunnel, Santa Rita Mines Co., School Section 16, Strong Mining Co., Teutonic, Unity Gold Corporation (Katinka group), and Volcano.

153336—37——23

GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE EASTERN AND CENTRAL STATES

(MINE REPORT)

By J. P. Dunlop and H. M. Meyer

SUMMARY OUTLINE

The output of gold, silver, copper, lead, and zinc from mines in the Eastern and Central States increased in 1936. The advances in gold and silver were not large, but copper increased more than 17,000 tons, lead nearly 17,000 tons, and zinc nearly 39,000 tons. Owing to the higher prices for copper, lead, and zinc, the total value of the metal output was much greater in 1936 than in 1935. There were no new large producers of copper, lead, or zinc in 1936, but most of the larger operators expanded their output.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the prices given in the table that follows. Gold in 1932 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1837, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95 per ounce, the yearly average weighted United States Government price[1]; and in 1935 and 1936 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1932 and 1933 is the average New York price for bar silver; in 1934, the Treasury buying price ($0.64646464+ per ounce) for newly mined silver; and in 1935 and 1936, the yearly average weighted Treasury buying price for newly mined silver. The copper, lead, and zinc prices are weighted yearly averages of all grades of primary metal sold by producers.

Prices of gold, silver, copper, lead, and zinc, 1932–36

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[1] $20.67+	$0.282	$0.063	$0.030	$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050

[1] $20.671835. [2] $0.64646464.

[1] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Mine production of gold, silver, copper, lead, and zinc in the Eastern and Central States, 1935–36, by States, in terms of recovered metals

State	Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)		Copper		Lead		Zinc		Total value
		Fine ounces	Value	Fine ounces	Value	Pounds	Value	Short tons	Value	Short tons	Value	
1935												
Eastern States:												
Alabama	15,067	2,227.24	$77,953	401	$288	10,061	$835					$79,076
Georgia	1,200	993.78	34,782	74	53							34,835
New Jersey	476,608									85,708	[1] $9,404,881	[1] 9,404,881
New York	295,179			21,750	15,633			(2)	(2)	23,720	2,087,360	[3] 2,102,993
North Carolina	37,487	2,175.57	76,145	7,584	5,451	(4)	(4)					[5] 81,596
Pennsylvania	1,048,792	745.00	26,075	5,843	4,200	(4)	(4)					[5] 30,275
South Carolina	17,467	2,273.51	79,573	1,117	803	240	20					80,396
Tennessee	1,390,240	423.00	14,805	47,151	33,890	[4] 20,802,110	[4] 1,726,575	[2] 4,982	[2] $398,560	[6] 48,832	[6] 4,297,216	[7] 6,471,046
Virginia	318,721	652.56	22,840	55	40	700	58	(2)	(2)	(6)	(6)	[8] 22,938
	3,600,761	9,490.66	332,173	83,975	60,358	20,813,111	1,727,488	4,982	398,560	158,260	15,789,457	18,308,036
Central States:												
Arkansas	(9)							38	3,040	153	13,464	16,504
Illinois	(9)			3,147	2,262			436	34,880			37,142
Kansas	2,900,100							10,892	871,360	54,110	4,761,680	5,633,040
Kentucky	(9)							132	10,560	127	11,176	21,736
Michigan	1,376,803			4,219	3,032	64,108,689	5,321,021					5,324,053
Missouri	3,636,600			110,551	79,459	67,660	5,616	97,493	7,799,440	7,263	639,144	8,523,659
Oklahoma	7,247,300							23,405	1,872,400	129,763	11,419,144	13,291,544
Wisconsin	236,000							286	22,880	8,923	785,224	808,104
	15,396,803			117,917	84,753	64,176,349	5,326,637	132,682	10,614,560	200,339	17,629,832	33,655,782
1936												
Eastern States:												
Alabama	30,829	4,726.00	165,410	869	673	14,000	1,288					167,371
Georgia	190	449.57	15,735	28	21							15,756
Maryland	1,370	668.00	23,380	33	26							23,406
New Jersey	526,233									89,883	[1] 9,868,010	[1] 9,868,010
New York	377,451			18,251	14,135			(10)	(10)	26,941	2,694,100	[3] 2,708,235
North Carolina	31,605	2,037.17	71,301	5,575	4,318	(4)	(4)	(10)	(10)			[11] 75,619
Pennsylvania	1,267,484	890.00	31,150	8,118	6,287	(4)	(4)					[8] 37,437
South Carolina	12,535	287.39	10,059	50	39							10,098
Tennessee	1,512,616	410.00	14,350	50,330	38,980	[4] 22,893,700	[4] 2,106,220	[10] 5,996	[10] 551,632	[6] 44,916	[6] 4,491,600	[12] 7,202,782
Virginia	491,830	908.97	31,814	96	75			(10)	(10)	(6)	(6)	[8] 31,889
	4,252,143	10,377.10	363,199	83,350	64,554	22,907,700	2,107,508	5,996	551,632	161,740	17,053,710	20,140,603

Central States:												
Arkansas	(9)							24	2,208	182	18,200	20,408
Illinois	(9)			1,780	1,379			294	27,048			28,427
Kansas	4,644,800							11,409	1,049,628	79,017	7,901,700	8,951,328
Kentucky	(9)							50	4,600	238	23,800	28,400
Michigan	3,225,600					95,968,019	8,829,058					8,829,058
Missouri	4,290,000			163,720	126,801	382,000	35,144	110,428	10,159,376	18,709	1,870,900	12,192,221
Oklahoma	9,085,600							25,427	2,339,284	129,175	12,917,500	15,256,784
Wisconsin	284,800							904	83,168	8,126	812,600	895,768
	21,530,800			165,500	128,180	96,350,019	8,864,202	148,536	13,665,312	235,447	23,544,700	46,202,394

1 Estimated smelting value of recoverable zinc content of ore after freight, haulage, smelting, and manufacturing charges are added.

2 New York and Virginia included under Tennessee; Bureau of Mines not at liberty to publish separate figures.

3 Excludes value of lead, which is included under Tennessee.

4 North Carolina and Pennsylvania included under Tennessee; Bureau of Mines not at liberty to publish separate figures.

5 Excludes value of copper, which is included under Tennessee.

6 Virginia included under Tennessee; Bureau of Mines not at liberty to publish separate figures.

7 Includes also value of copper from North Carolina and Pennsylvania, lead from New York and Virginia, and zinc from Virginia.

8 Excludes value of lead and zinc, which is included under Tennessee.

9 No figures available for small quantity of ore treated in Arkansas, Illinois, or Kentucky.

10 New York, North Carolina, and Virginia included under Tennessee; Bureau of Mines not at liberty to publish separate figures.

11 Excludes value of copper and lead, which is included under Tennessee.

12 Includes also value of copper from North Carolina and Pennsylvania; lead from New York, North Carolina, and Virginia; and zinc from Virginia.

Number of lode and placer mines producing and yield of gold and silver in the Eastern States, 1935–36, by States

State	Number of mines		Gold (fine ounces)		Silver (fine ounces)	
	Lode	Placer	Lode [1]	Placer	Lode [1]	Placer
1935						
Alabama	3	2	2,222.15	5.09	401	
Georgia	6	30	661.28	332.50	64	10
New Jersey	1					
New York	2				21,750	
North Carolina	15	17	2,084.73	90.84	7,578	6
Pennsylvania	1		745.00		5,843	
South Carolina	8	12	2,130.51	143.00	1,109	8
Tennessee	5		423.00		47,151	
Virginia	3	3	498.74	153.82	52	3
	44	64	[1] 8,765.41	725.25	[1] 83,948	27
1936						
Alabama	1		4,726.00		869	
Georgia	2	35	145.31	304.26	17	11
Maryland	1		668.00		33	
New Jersey	1					
New York	2				18,251	
North Carolina	9	9	2,008.80	28.37	5,572	3
Pennsylvania	1		890.00		8,118	
South Carolina	5	2	282.22	5.17	49	1
Tennessee	5		410.00		50,330	
Virginia	3	1	907.43	1.54	95	1
	30	47	[1] 10,037.76	339.34	[1] 83,334	16

[1] 1935: Dry and siliceous ores (48,275 tons) yielded 7,417.41 ounces of gold and 2,244 ounces of silver, copper ore (666,667 tons) yielded 603 ounces of gold and 54,057 ounces of silver, lead-zinc ore (543,248 tons) yielded 21,804 ounces of silver, pyritiferous magnetite ore (1,048,792 tons) yielded 745 ounces of gold and 5,843 ounces of silver, and zinc ore (1,293,779 tons) yielded no gold or silver; 1936: Dry and siliceous ores (63,577 tons) yielded 8,622.76 ounces of gold and 2,231 ounces of silver, copper ore (681,931 tons) yielded 525 ounces of gold and 53,248 ounces of silver, lead-zinc ore (788,336 tons) yielded 19,737 ounces of silver, pyritiferous magnetite ore (1,267,484 tons) yielded 890 ounces of gold and 8,118 ounces of silver, and zinc ore (1,450,815 tons) yielded no gold or silver.

Gold.—The output of gold in the Eastern States was 10,377.10 fine ounces in 1936—only 886.44 ounces more than in 1935. This relatively small increase is disappointing when compared with the large gains in most of the Western States. Gold derived from siliceous ores increased from 7,417.41 to 8,622.76 ounces and that from the refining of copper bullion from 1,350 to 1,415 ounces, but the yield from placer mines decreased from 725.25 to 339.34 ounces. Four mines—one each in Alabama, Maryland, North Carolina, and Virginia—produced more than 76 percent of the total gold recovered in the Eastern States in 1936. Yields of gold were reported from 24 lode mines and 47 placers in 1936 compared with 37 and 64, respectively, in 1935. None of the placer mines in 1936 yielded as much as 100 ounces of gold. The estimated output of gold in the Southern Appalachian States from 1799 to 1936, inclusive, is recorded as 2,504,936 fine ounces valued at $52,128,885.

In 1936, 63,577 tons of siliceous ore (from mines in Alabama, Georgia, Maryland, North Carolina, South Carolina, and Virginia) were treated, of which 63,009 tons were treated at gold and silver mills and 568 tons (mainly from North Carolina) were shipped crude to smelters. Gold concentrates amounting to 2,262 tons shipped to smelters yielded 6,362.28 ounces of gold, whereas bullion from gold milling plants yielded only 1,674.28 ounces of gold. Copper concentrates shipped to smelters yielded 1,250 ounces of gold. In 1935, 48,275 tons of siliceous ore were treated, of which 19,987 tons went to gold and silver mills, 2,831 tons were shipped crude to smelters,

and 25,457 tons were sent to all-flotation mills. Crude siliceous ore shipped to smelters yielded 586.20 ounces of gold in 1936 compared with 2,351.61 ounces in 1935.

No mines in the Central States yielded any gold in 1936 or 1935.

Silver.—Of the silver (83,350 ounces) produced in the Eastern States in 1936, 16 ounces came from placer bullion, 145 ounces from bullion recovered at gold and silver mills, 71,569 ounces from concentrates smelted, and 11,620 ounces from crude ore shipped to smelters. Siliceous ores yielded 2,231 ounces, placer mines 16 ounces, lead-zinc ores from New York and Tennessee 19,737 ounces, and copper ore 53,248 ounces; the rest of the silver came from copper concentrates recovered by flotation from pyritiferous magnetite ore.

The production of silver in the Central States in 1936 totaled 165,500 ounces. The output in Illinois (1,780 ounces) came from galena concentrates recovered in milling fluorspar, and that in Missouri (163,720 ounces) was from the refining of lead bullion, slags, and skimmings recovered from the lead ores of southeastern Missouri.

Copper.—The mine production of copper in the Eastern States was 22,907,700 pounds valued at $2,107,508 in 1936 compared with 20,813,111 pounds valued at $1,727,488 in 1935. The output of copper from Tennessee mines increased about 2,000,000 pounds and that from Pennsylvania about 600,000 pounds. The Bureau of Mines is not at liberty to show the copper production by States. The gold concentrates shipped to smelters from Alabama and North Carolina yielded small quantities of copper, but most of the copper was derived from copper ore mined in North Carolina and Tennessee and from copper concentrates recovered from Pennsylvania pyritiferous magnetite ore mined for its iron content. The output of copper from gold concentrates in 1936 was 67,900 pounds. The copper ore yielded about 0.008 ounce of gold and 0.08 ounce of silver to the ton of crude ore. The copper concentrates from the magnetite ore contained about 25.6 percent copper and about 0.10 ounce of gold and 0.91 ounce of silver a ton.

The copper output of the Central States came from copper ore from Michigan and lead ore from Missouri; no copper ore was shipped from Missouri in 1936 or 1935, and the copper reported was derived from the treatment of residues from lead smelted. The output of refined copper in Michigan increased from 64,108,689 pounds in 1935 to 95,968,019 pounds in 1936, whereas the average recovery per ton of rock declined from 46.6 to 29.8 pounds.

Lead.—The lead produced from mines in the Eastern States in 1936 came from lead-zinc ores from the Austinville mine in Virginia, the Balmat mine in New York, and the Embree mine in Tennessee; a little lead was reported produced in North Carolina in 1936. Shipments of galena concentrates totaled 9,199 tons and yielded 5,996 tons of lead—1,014 tons more than the yield in 1935.

The lead recovered from shipments of lead ore and concentrates in the Central States increased from 132,682 tons in 1935 to 148,536 tons in 1936, due mainly to increased shipments from southeastern Missouri and from the Tri-State region in Oklahoma and Kansas. Missouri shipments yielded 110,428 tons of lead in 1936 compared with 97,493 tons in 1935. Recovered lead in shipments from Oklahoma mines totaled 25,427 tons in 1936 and 23,405 tons in 1935, and shipments of lead concentrates from Kansas mines yielded 11,409 tons of lead in 1936 and 10,892 tons in 1935. Wisconsin mines

produced ore yielding 904 tons of lead in 1936 and 286 tons in 1935. Lead production of Kentucky decreased from 132 tons in 1935 to 50 tons in 1936, that of Illinois from 436 to 294 tons, and that of Arkansas from 38 to 24 tons. Mines in the Tri-State or Joplin region shipped 52,256 tons of lead concentrate yielding 38,842 tons of lead in 1936.

Zinc.—The recoverable zinc in ore and concentrates shipped from mines in the Eastern States was 161,740 tons valued at $17,053,710 in 1936 compared with 158,260 tons valued at $15,789,457 in 1935. Mines in New Jersey yielded nearly 90,000 tons as metal or in oxide valued at $9,868,010.

[N. B.—The value of the zinc in New Jersey is the estimated smelting value of the recoverable zinc content of the ore after freight, haulage, smelting, and manufacturing charges are added.]

Mines in New York increased their output of recoverable zinc from 23,720 tons in 1935 to 26,941 tons in 1936. The zinc is partly from zinc ore and partly from lead-zinc ore. Zinc sulphide ores yielded all the zinc from Tennessee except that derived from about 4,280 tons of zinc carbonate ore mined and shipped. The recovered zinc content of sphalerite concentrates shipped from mines in Virginia may not be disclosed, but that of concentrates shipped from Tennessee and Virginia in 1936 was 44,916 tons. There was a decrease in the output from Virginia but a small increase in that from Tennessee.

Zinc concentrates shipped from mines in the Central States had a recoverable zinc content of 235,447 tons in 1936 compared with 200,339 tons in 1935. Mines in the Tri-State region shipped ore and concentrates yielding 226,857 tons of zinc in 1936 (191,136 tons in 1935), of which Oklahoma contributed 57 percent and Kansas 35 percent. Stocks of sphalerite were negligible at the end of 1936. The recoverable zinc in shipments from Wisconsin decreased from 8,923 tons in 1935 to 8,126 tons in 1936; it increased in shipments from Missouri mines from 7,263 to 18,709 tons. In 1935, all the Missouri zinc came from southwestern Missouri, but in 1936 a small shipment of sphalerite was made from southeastern Missouri. Illinois mines shipped no zinc concentrate in 1936. Recoverable zinc from Kentucky increased from 127 to 238 tons. Arkansas shipments of zinc carbonates continued small; the recovered zinc increased from 153 to 182 tons.

MINE PRODUCTION IN THE EASTERN STATES

Alabama.—The quantity of gold produced in Alabama from 1830 to 1936, inclusive, is recorded as 46,949.37 fine ounces. The yield in 1936 was 4,726 ounces and was mainly that of the Hog Mountain Gold Mining & Milling Co., in Tallapoosa County, 13 miles northeast of Alexander City, which mined and treated about 48.5 percent of all the siliceous ore treated in the Appalachian States in 1936. The exact production of the Hog Mountain mine is not known, but the output from 1839 to 1915 was probably $250,000. The mine was idle from 1845 to 1896; it was then reopened, a 75-ton cyanide plant was erected, and about 100,000 tons of ore were treated between 1896 and 1916 when the mine was abandoned; it was not reopened until 1933. The sulphide ore now being mined is treated at a 150-ton all-flotation plant first operated in February 1934. The crude ore contains about 0.20 to 0.22 ounce of gold to the ton, with traces of copper and silver. The concentrates, which are shipped to the Nichols Copper Co., yield about 2.75 ounces of gold and 0.42 ounce of silver to the ton and 0.62

percent of copper. The mine and mill were operated steadily in 1936 and a total of 310,000 man-hours was worked. The mine is equipped with a double-compartment shaft 215 feet deep; 1,119 feet of development work were done in 1936. Mining and milling methods at the Hog Mountain mine are given in a recent publication [2] of the Bureau of Mines.

The Gold Log mine 9 miles west of Talladega was not operated in 1936. The property has been acquired by the Guy S. Amos Mining Co. There is a 320-foot shaft at the mine, and a 100-ton amalgamation and flotation plant is under construction in 1937.

Georgia.—The quantity of gold produced in Georgia from 1830 to 1936, inclusive, is recorded as 866,922 fine ounces. In 1936, 35 placers and 2 lode mines yielded a total of 449.57 ounces of gold and 28 ounces of silver. Of the 304.26 ounces of placer gold produced, 77.57 ounces came from mines near Dahlonega and Auraria in Lumpkin County, 183.51 ounces from mines near Sautee, Nacoochee, and Helen in White County, and the remainder from small mines in Carroll, Cherokee, Hall, Paulding, Rabun, Union, and Wilkes Counties. The larger shippers of placer gold in 1936 were the Ferey Gold Mining Co., Dixie Gravel Co., T. J. Stevenson, and H. L. Schwalbe, all in White County. Gold recovered from less than 200 tons of siliceous ores amounted to 145.31 ounces, mainly from the Battle Branch and McDonald mines at Dahlonega in Lumpkin County. The Battle Branch mine was operated by the Southern Mineral Development Co. The company has a 10-stamp amalgamation concentration mill; no concentrates were shipped in 1936, but about 550 feet of development work were done. The McDonald mine is an open-cut operation equipped with a 5-stamp amalgamation plant. The property of the 301 Mining Co. at Hollysprings in Cherokee County was idle in 1936, but it is probable that the 12-stamp amalgamation-concentration plant will be operated in 1937. Lessees of the Barlow mine at Dahlonega were testing methods of operating it. Other properties at Dahlonega controlled by Dr. Craig R. Arnold awaited construction of milling equipment. The Capps and adjoining properties, including the Crown Mountain, were acquired by O. S. Sykes, who is endeavoring to finance the group and construct a large mill. The Burnt Hickory Mining Co. of Atlanta operated a mine near Dallas in Paulding County and recovered some gold by sluicing; the mine was operated for a few months only and was closed in the fall of 1936 for installation of a power shovel and a machine for washing gravel.

Maryland.—The total gold production of Maryland to the end of 1936 is estimated at 4,135.71 fine ounces. Until 1936 no gold had been produced in Maryland for many years, but in 1935 the Maryland Mining Co. did some development work in Montgomery County and in 1936 was the third largest producer of gold from gold ore in the Eastern States. No expensive plant or buildings have been erected, the milling equipment consisting of a small stamp and amalgamation concentration plant built for experimental purposes. The mine is equipped with a 200-foot, three-compartment shaft, and ore is mined at the 150- and 200-foot levels. A small shipment of concentrates was made in 1936 to Carteret, N. J., but excessive charges for freight, etc., on this shipment resulted in the holding of other concentrates pending

[2] Johnson, N. O., Mining and Milling Methods and Costs, Hog Mountain Gold Mining & Milling Co., Alexander City, Ala.: Inf. Circ. 6914, Bureau of Mines, 1936, 23 pp.

their treatment at the property. A considerable part of the gold was panned from rich ore; the ore treated at the mill ran about $17 to the ton; and the tailings were impounded for future treatment. The bullion sent to the mint was 950 fine and contained very little silver. The property controlled covers about 250 acres and is said to show numerous veins of good ore. The conservative operation of the company has attracted considerable attention to the fact that the property is being worked close to the boundaries of the District of Columbia.

New Jersey (see also note on p. 348).—The production of zinc ore in New Jersey in 1936 was 526,233 tons containing 89,883 tons of recoverable zinc as metal or in oxide. The only producing properties were the Sterling and Mine Hill mines; these mines were operated about 257 days in 1936 and have a much larger potential output.

New York.—The quantity of zinc ore mined and treated in New York increased from 80,731 tons in 1935 to 92,749 tons in 1936 and that of lead-zinc ore from 214,448 to 284,702 tons. The concentrates shipped yielded 26,941 tons of zinc and more than 1,000 tons of lead; the lead concentrates from the Balmat mine contain considerable silver also. The Balmat mine is near Sylvan Lake; it produces lead-zinc ore, is equipped with a 1,200-ton all-flotation concentration plant, and has a shaft 900 feet deep. The shaft at the Edwards mine is 1,900 feet deep, and the all-flotation plant has a capacity of 330 tons. About 170 men were employed 312 days at the Balmat mine and mill, and about 85 men worked 312 days at the Edwards mine.

North Carolina.—The quantity of gold produced in North Carolina from 1799 to 1936, inclusive, is recorded as 1,151,850.27 fine ounces. The yield in 1936 was 2,037.17 ounces, of which 28.37 ounces came from nine placers and 2,008.80 ounces from nine lode mines. The output of silver was 5,575 ounces, of which 1,171 ounces came from placers and lode-gold mines and the remainder from copper ore. The Fontana copper mine was the largest producer of silver and the second largest producer of gold in North Carolina in 1936, although the assay content of gold and silver in ore shipped from this mine is very low. The meager output of placer gold came from mines in Cabarrus, Catawba, Guilford, Iredell, Randolph, Rutherford, and Union Counties. None of the properties yielded more than a few ounces. Much the largest producer of lode gold in North Carolina in 1936 was the Rudisil mine, the second largest producer of gold in the Appalachian States. The lode gold came from mines in Cabarrus, Franklin, Gaston, Mecklenburg, Randolph, Stanly, and Swain Counties.

The North Carolina Exploration Co. shipped crude sulphide copper ore from the Fontana mine in Swain County to the Tennessee Copper Co. smelter at Copperhill, Tenn.; the ore is said to average 0.009 ounce of gold and 0.23 ounce of silver to the ton. Most of the gold production of North Carolina in 1936 was that of the Rudisil Gold Mine, Inc., operating a mine and mill near Charlotte, in Mecklenburg County. The sulphide ore containing gold, silver, and a little copper was treated at a 50-ton flotation mill. The concentrates and some crude ore were shipped to Carteret, N. J., for smelting. The mine is opened by a 300-foot vertical shaft, and about 300 feet of development were done in 1936. The Allen Furr mine in Cabarrus County near Stanfield was operated by Midas Mines, Inc.; concentrates shipped to Carteret contained about 0.76 ounce of gold and 5 ounces

of silver to the ton. The Portis mine in Franklin County, owned by the Norlina Mining Co., was leased to the Appalachian Gold Corporation; it yielded some gold from a stamp and amalgamation mill. The Snyder mine in Cabarrus County was operated by A. L. Nash part of 1936, and some dump ore was treated at a 5-stamp mill. R. L. Stover of Belmont, Gaston County, shipped a car of ore to Carteret for treatment. The Keystone Mining Co. operated the Jones and Keystone mines near Fullers in Randolph County; the ore was taken from open-cut workings and treated at a 120-ton amalgamation-flotation plant. The H & G mine in Randolph County was operated a short time by H. L. Griswold, and some bullion was shipped. The Thompson mine near Albemarle in Stanly County was worked by Cohen Bros., and small shipments of bullion were made to the Philadelphia Mint. The Hoover Hill Mining Co. operated its property in Randolph County about 126 days in 1936; development work only was done. The Keystone Mining & Milling Co. continued development work at its property at Union Mills in Rutherford County but did not operate its milling plant. Apparently no ore or bullion was shipped from properties in the Gold Hill district in Rowan County.

Pennsylvania.—The Cornwall mine in Lebanon County was operated at a greatly increased rate in 1936, and more than 8,900 tons of copper concentrates were shipped. The ore is pyritiferous magnetite, and the tailings from the iron concentrates go to a flotation plant; the copper concentrates, which contain about 25 percent copper and 0.10 ounce of gold and 1 ounce of silver to the ton, were shipped to the Nichols Copper Co. The mine has an open-cut, an inclined shaft, and 1,500 feet of drifts; it was operated about 295 days in 1936, the concentrating plant 340 days.

South Carolina.—From 1829 to 1936, inclusive, mines in South Carolina yielded 254,249.72 fine ounces of gold. The output in 1936 from five lode mines and two placers was 287.39 ounces, of which 282.22 ounces came from lode mines and 5.17 ounces from placers. Gold-milling plants recovered 233.22 ounces of gold and 36 ounces of silver, and 85 tons of crude ore shipped to smelters yielded 49 ounces of gold. The lode mines yielded 49 ounces of silver and the placers 1 ounce. Ten gold mines milled or shipped about 12,535 tons of siliceous ore. The large decline in output of gold in 1936 was due to the decrease in crude ore shipped to smelters; the Dickey mine in Cherokee County near Smyrna was the only shipper of crude ore in 1936. The Terry mine, also near Smyrna and formerly operated by Shorey C. Guess, was idle in 1936. The old Haile mine in Lancaster County near Kershaw had a comparatively small output; however, it yielded nearly all the gold produced from lode mines. The 50-ton amalgamation plant was closed in April 1936, but the operators have completed plans for the construction of a 250-ton cyanide plant. The first unit of this plant was expected to be in operation by April 1, 1937, and the second unit by August 1. The mine is reported to have yielded about $3,200,000 since 1828. It has been worked by an open-cut about 80 feet deep. The Hayes Gold Mining Co. in Lancaster County at Kershaw mined some ore which was treated at a small pilot mill; the company expects an increased output when a larger mill is operated in 1937. The Thirty-Five Mining Co. at Hickory Grove, York County, did not mill or ship any ore in 1936 but carried on development throughout the year. The shaft at the mine is 106 feet deep, and about 500 feet of drifts were run in 1936 No

milling plant will be constructed until further development is done. The Southern Gold Mining Co. and the White Star Milling Co. made little output.

Tennessee.—Mines in Tennessee produced 18,975.88 fine ounces of gold from 1831 to 1936, inclusive; almost the entire output since 1906 has come from copper ore, and copper bullion was the sole source of the 410 ounces produced in 1936. The output in 1935 was 423 ounces. The quantity of silver recovered from copper ore increased from 47,151 ounces in 1935 to 50,330 ounces in 1936. The Embree Iron Co., the only producer of lead in Tennessee in 1936, shipped four times as much lead concentrate as in 1935. The production of copper increased considerably, and that of zinc was about 700 tons more than in 1935.

The total output of copper from mines in Tennessee, North Carolina, and Pennsylvania was 22,893,700 pounds in 1936 compared with 20,802,110 pounds in 1935; the large increase came from mines in Tennessee and Pennsylvania. The total lead recovered from mines in Tennessee, New York, Virginia, and North Carolina was 5,996 tons in 1936 compared with 4,982 tons from Tennessee, New York, and Virginia in 1935; about 600 tons of the increase came from Tennessee and the remainder from Virginia. The total zinc recovered from mines in Tennessee and Virginia was 44,916 tons in 1936 compared with 48,832 tons in 1935. The Bureau of Mines is not at liberty to publish figures for the foregoing States separately.

The Tennessee Copper Co. ran its 1,200-ton-per-day flotation plant and smelter continuously in 1936 on ore from the Burra Burra mine in Tennessee, on sulphide ores from the Fontana mine in Swain County, N. C., and during the latter part of the year on ore from the Isabella mine in Tennessee; very little ore was received from mines in other States. The zinc concentrates, averaging 49 percent zinc, were shipped to the American Steel & Wire Co. plant at Donora, Pa.; the copper bullion was sent to the Nichols Copper Co. The Ducktown Chemical & Iron Co. operated its Isabella mine and 700-ton flotation plant until August 31 (172 days) and shipped the concentrates to the Nichols Copper Co. The entire property of the company at Isabella was acquired the last of August by the Tennessee Copper Co., which operated it after that time. The Mascot mine and mill of the American Zinc Co. of Tennessee were operated 283 days. The mine is opened by a shaft, and the average depth of mining is 500 feet. The output of zinc was greater than in 1935. The Universal Exploration Co. mine in Jefferson County was worked steadily but not at capacity in 1936. The large 800-ton all-flotation mill was operated 293 days on sulphide ore from two shafts about 200 feet deep. The carbonate zinc ore was mined 220 days; it was treated at a 100-ton mill not equipped for flotation. The average grade of the carbonate concentrates was 41.87 percent zinc and that of the sphalerite concentrates 64.57 percent. This sphalerite is probably of higher grade than that shipped from any other mine in the United States. The Embree Iron Co. in Washington County shipped less zinc carbonate in 1936 than in 1935 but increased greatly the quantity of lead carbonate ore shipped to smelters. The mine and log washer were operated steadily throughout the year.

Virginia.—The quantity of gold produced from Virginia mines from 1828 to 1936, inclusive, is recorded as 161,853.50 fine ounces, of which only 2,767 ounces were produced during the past 25 years. In 1936

the output of the State was 908.97 ounces of gold and 96 ounces of silver from three lode mines and one placer. Shipments of zinc concentrates decreased in 1936 and those of galena concentrates increased about 600 tons, but the Bureau of Mines is not at liberty to publish the figures for zinc or lead output as the Austinville mine of the Bertha Mineral Co. is the only producer of lead-zinc ore in Virginia. The mine and 1,200-ton concentration flotation mill were operated steadily throughout the year; about one-third of the mill output comes from flotation.

Most of the gold output of Virginia in 1936 came from the Vaucluse mine near Wilderness in Orange County, operated by the Virginia Mining Corporation. This mine has a vertical shaft 300 feet deep, and 1,000 feet of drifts were run in 1936. The sulphide ore is treated in a 90-ton all-flotation plant, and the concentrates are shipped to Carteret, N. J. The milling plant, pumps, hoists, etc., are operated electrically. The mine was worked 240 days and the mill 100 days. The Moss Mining Co. operated a lode mine, equipped with a 25-ton amalgamation plant, at Tabscott in Goochland County. The gold recovery was good considering the small quantity of ore milled. The Peabody Mining Corporation in Goochland County was the only operator of placer property in Virginia in 1936. No output was reported from the Ruth placer of the Powhatan Mining Corporation, also in Goochland County.

MINE PRODUCTION IN THE CENTRAL STATES

Quantity and tenor of ores.—The only fair basis for comparing the relative magnitude of mining in different States is the quantity of crude ore or "dirt." The metal content of the ores of the several mining regions and States exhibits marked differences; therefore, comparison of tenor of the ores is interesting and significant. Virtually all the ore from the Central States is of such low tenor as to require concentration. In Kentucky and southern Illinois most of the lead and zinc concentrates are recovered as byproducts in the concentration of the fluorspar that they accompany, and the metal content of the crude ore raised cannot be calculated. In Arkansas very little ore has been mined for several years, and the average tenor calculated from the output of ore during these years would not offer accurate comparison with that during a period of active mining.

Quantity and tenor of copper, lead, and zinc ores, old tailings, etc., produced in the Central States, 1934–36, by States

State	1934		1935		1936	
	Ore, etc.	Metal content [1]	Ore, etc.	Metal content [1]	Ore, etc.	Metal content [1]
	Short tons	*Percent*	*Short tons*	*Percent*	*Short tons*	*Percent*
Kansas	2,096,700	2.67	2,900,100	2.41	4,644,800	2.09
Michigan	700,055	3.44	1,376,803	2.33	3,225,600	1.49
Missouri	3,415,000	2.94	3,636,600	2.96	4,290,000	3.12
Oklahoma	5,927,400	2.35	7,247,300	2.28	9,085,600	1.84
Wisconsin	308,600	3.69	236,000	4.97	284,800	3.93
	12,447,755		15,396,803		21,530,800	

[1] The percentages represent the metal content of the ore insofar as it is recovered in the concentrates. In Michigan the metal so recovered is copper; in other Central States the metals are lead and zinc combined, the relative proportions of which are shown in the table on p. 344 and in the tables of tenor of ore given in the sections devoted to the respective States.

Production of lead and zinc by regions.—The report of this series for 1930 (chapter of Mineral Resources of the United States, 1930, pt. I) gives the areas included in the seven lead- and zinc-producing regions of the Central States. Mineral Resources, 1914, contains brief reviews of the history of lead and zinc mining in the Central States, the yearly production of each State from 1907 to 1914, inclusive, and historical notes and estimates of the total production of lead and zinc in each State before 1907. Subsequent records year by year are found in Mineral Resources and Minerals Yearbook.

Mine production of lead and zinc in the Central States, 1935–36, by regions

Region	Lead [1]		Zinc [2]		Total value
	Short tons	Value	Short tons	Value	
1935					
Concentrates:					
Joplin or Tri-State	45,926	$1,939,296	362,629	$10,388,102	$12,327,398
Southeastern Missouri	131,405	6,998,116			6,998,116
Upper Mississippi Valley [3]	398	16,963	33,027	379,262	396,225
Kentucky-southern Illinois	797	29,751	[4] 377	6,101	35,852
Northern Arkansas	50	2,000	435	7,140	9,140
	178,576	8,986,126	396,468	10,780,605	19,766,731
Metal:					
Joplin or Tri-State	34,849	2,787,920	191,136	16,819,968	19,607,888
Southeastern Missouri	96,941	7,755,280			7,755,280
Upper Mississippi Valley [3]	286	22,880	8,923	785,224	808,104
Kentucky-southern Illinois	568	45,440	127	11,176	56,616
Northern Arkansas	38	3,040	153	13,464	16,504
	132,682	10,614,560	200,339	17,629,832	28,244,392
1936					
Concentrates:					
Joplin or Tri-State	52,256	2,625,887	428,524	14,198,122	16,824,009
Southeastern Missouri	145,575	7,278,750	112	2,016	7,280,766
Upper Mississippi Valley [3]	1,277	61,198	38,276	400,899	462,097
Kentucky-southern Illinois	506	23,465	693	13,159	36,624
Northern Arkansas	30	1,450	494	8,040	9,490
	199,644	9,990,750	468,099	14,622,236	24,612,986
Metal:					
Joplin or Tri-State	38,842	3,573,464	226,857	22,685,700	26,259,164
Southeastern Missouri	108,422	9,974,824	44	4,400	9,979,224
Upper Mississippi Valley [3]	904	83,168	8,126	812,600	895,768
Kentucky-southern Illinois	344	31,648	238	23,800	55,448
Northern Arkansas	24	2,208	182	18,200	20,408
	148,536	13,665,312	235,447	23,544,700	37,210,012

[1] Includes galena and a small quantity of lead carbonate concentrates.
[2] Includes sphalerite and a small quantity of zinc carbonate and zinc silicate concentrates.
[3] Includes Iowa, northern Illinois, and Wisconsin.
[4] Includes some lead-zinc ore.

REVIEW BY STATES

Arkansas.—In 1936, 494 tons of zinc carbonate and mixed zinc carbonate and sulphide were shipped from about 10 mines in Arkansas; the recoverable zinc in the concentrates was 182 tons. In 1935, 435 tons of zinc carbonate were shipped. None of the mines gave any data for 1936 on their operations or shipments, but the smelters that purchased the concentrates gave the information. Shipments of zinc concentrates were made from the Lonnie Boy and other mines of the Urschel Lead & Zinc Co., the McIntosh mines, and the Edith mine, all in the Rush district; other shipments were made of small lots purchased from scrappers in the Kingdom, Hall Mountain, and Dodd City districts. The only shipments of lead concentrates from Arkansas in 1936 were about 30 tons purchased by the Eagle-Picher

Mining & Smelting Co. from the Ponca district; the recoverable lead content was 24 tons. The higher prices now being paid for zinc carbonate and galena concentrates may increase shipments from Arkansas in 1937, although the Urschel mill at Rush was burned in October 1936.

Illinois.—No lead or zinc mines in Illinois were operated in 1936 or 1935. Shipments of galena from fluorspar mines in southern Illinois in 1936 totaled 410 tons of galena concentrates having an average lead content of 73.2 percent; 294 tons of lead and 1,780 ounces of silver were recovered from these shipments compared with 436 tons of lead and 3,147 ounces of silver recovered in 1935. The Hillside Fluor Spar Mines at Rosiclare was the largest shipper in both 1936 and 1935.

Kansas.—Shipments of galena concentrates from mines in Kansas totaled 14,789 tons having a recoverable lead content of 11,409 tons in 1936 compared with 14,301 and 10,892 tons, respectively, in 1935. The quantity of sphalerite concentrates shipped was 149,095 tons with a recoverable zinc content of 79,017 tons in 1936 compared with 102,078 and 54,110 tons, respectively, in 1935. The total quantity of concentrates made by flotation was 62,550 tons of sphalerite and 2,730 tons of galena in 1936 compared with 51,770 and 5,712 tons, respectively, in 1935. The total number of lead and zinc mines operated in Kansas in 1936 was about 50. The number of milling plants operated was less than 30.

Mine shipments of lead and zinc in Kansas, 1935–36

Year	Lead concentrates		Zinc concentrates		Metal content [1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935	14,301	$579,690	102,078	$2,948,509	10,892	$871,360	54,110	$4,761,680
1936	14,789	765,746	149,095	5,473,457	11,409	1,049,628	79,017	7,901,700

[1] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and old tailings milled and concentrates produced in Kansas, 1935–36

	1935		1936	
	Crude ore	Old tailings	Crude ore	Old tailings
Total ore and old tailings milled .... short tons	1,337,400	1,562,700	1,822,900	2,821,900
Total concentrates shipped:				
Galena .... do	14,291	10	14,577	212
Sphalerite .... do	82,288	19,790	115,475	33,620
Ratio of concentrates to ore, etc.:				
Lead .... percent	0.82	----------	0.73	0.01
Zinc .... do	6.33	1.27	6.06	1.19
Metal content of ore, etc.:				
Lead .... do	.64	----------	.59	.005
Zinc .... do	3.83	0.75	3.65	0.71
Average lead content of galena concentrates .... do	77.7	70.0	78.9	67.4
Average zinc content of sphalerite concentrates .... do	60.5	58.9	60.2	60.1
Average value per ton:				
Galena concentrates	$40.54	$40.00	$51.92	$42.32
Sphalerite concentrates	29.26	26.81	32.22	30.27

There was only a small output from the Lawton camp; it was made by small operators using hand jigs or from crude ore trucked to the Playter custom mill at Waco. The 2,800 tons of crude ore yielded 15 tons of galena and 156 tons of sphalerite concentrates. Virtually no mining was done at the Crestline camp, and the output in the Kansas part of the Waco area was almost entirely from tailings treated at two mills—the Bailey Mining & Milling Co. and the R. H. & G. Mining Co. The two mills operated only a part of 1936 and shipped 2,118 tons of sphalerite. No output of lead was reported. The total output of all the above camps in 1935 was 66 tons of galena and 3,212 tons of sphalerite. Operations at the old Galena camp in both 1936 and 1935 were confined to scrapping and the treatment of dump ore. The output was about 62 tons of galena and 178 tons of sphalerite in 1936 and 310 tons of lead concentrate and 70 tons of sphalerite in 1935. Mines and mills near Baxter Springs shipped 3,092 tons of galena and 22,052 tons of sphalerite in 1936 compared with 5,598 and 15,814 tons, respectively, in 1935. The St. Louis Smelting & Refining Co. was the largest producer of galena and sphalerite in this area in 1936. Considerable drilling was done late in the year, and operations will be extended to several hundred acres where work has been dormant for several years. In 1936 the large producers from tailings were the Beck Mining & Milling Co., the O. W. Bilharz Mining Co., and the Baxter Chat Co. Ore was mined and milled or shipped to custom mills from the Hocker, Robob, Iron Mountain, Blue Circle, Peru, Ballard, and Wade mines. The old Peru mine was finally worked out and abandoned, and the Paxton mine, long idle, was being dewatered. Mines in the Blue Mound-Treece area shipped 8,327 tons of galena and 82,942 tons of sphalerite in 1935 but increased their output to 11,620 tons of galena and 124,591 tons of sphalerite in 1936. Part of the 1936 shipments were of concentrates made in 1934 and 1935.

Output from the treatment of tailings and from crude ore increased; a large part of the crude ore was trucked to the Central mill in Oklahoma for treatment, including the ore from the Mid-Continent, Bendelari, Big John, Ace High, Gray Wolf, and Northern leases. The Black Eagle was purchased in April 1936 by the Mary M. Mining Co., and the mill was run partly on ore and partly on old tailings. A large quantity of the stored sphalerite at the Jarrett mine of the Federal Mining & Smelting Co. was sold in December, and the mine bins were cleaned up early in 1937. The Muncie mill of the Federal Mining & Smelting Co. was operated in 1936, but the Jarrett mill was idle. The largest producing mine in Kansas in 1936 was the Barr of the Vinegar Hill Zinc Co.; other producing properties were the Mid-Continent, No. 14 of the Evans Wallower Lead Co., Wilbur of the Commerce Mining & Royalty Co., Blue Mound of J. P. Dines, Robinson of the American Zinc, Lead & Smelting Co., Cherokee, Big Elk, and Redskin. The Big Elk mine was equipped with a new milling plant in 1936. The eight tailing mills operating in this area in 1936 made a very large output (22,519 tons) of sphalerite but only 200 tons of galena. The largest mill, that of the Captain Milling Co., treated tailings from the Wilbur and Bendelari mines; it was built in 1936.

Kentucky.—In 1936 about 10 mines in Kentucky shipped 693 tons of zinc carbonate and 96 tons of lead carbonate yielding 238 tons of zinc and 50 tons of lead. The concentrates sold were shipped largely

by Avery H. Reed, of Marion, who operated the K & K mine and also purchased ore or concentrates from the Aluminum Ore Co. and from operators of the Blue & Marble, Hudson, Davenport, Columbia, Miller, and Tyrie mines near Marion. Other shippers were the Hickory Consolidated Mining Co. operating the old Sheridan property and Roberts & Frazer who mined on Kentucky Fluorspar Co. property. The zinc carbonate shipped averaged 38 to 40 percent zinc and the lead carbonate about 50 percent lead.

Michigan.—No gold or silver was produced in 1936 or 1935 from the properties at Ishpeming. At the Michigan mine an average of 20 men was employed during most of 1936; development was done at the 270-foot level, and a 100-ton flotation plant was being installed. The Ishpeming Gold Mining Co. continued to drill and sample the old Ropes mine and adjoining land.

Copper was produced in Michigan in 1936 by the two companies that have furnished the output of the State since 1932. A total of 3,225,600 tons of rock and sands was treated and yielded 141,166,376 pounds of mineral containing 95,968,019 pounds of recoverable copper. Nearly half (1,547,000 tons) of the gross tonnage treated was sands which contained 19,167,000 pounds of recoverable copper. The large increase in tonnage of sands treated was partly responsible for the sharp drop in average copper content of rock treated in 1936 to 1.49 percent compared with 2.33 percent in 1935 and 3.44 percent in 1934. Exclusive of sands, however, the grade dropped from 3.65 percent in 1935 to 2.29 percent in 1936. The drop in grade of rock treated, exclusive of sands, was the first recorded since the policy of selective mining was inaugurated to combat depression prices.

The increasing price for copper in the latter part of 1936 led to plans for the reopening of the Quincy mine, closed since September 22, 1931. In order to reopen the property an assessment was made on the stockholders. In a letter to stockholders early in 1937 the president reported that good progress was being made in preparing the mine for production and that indications were that the mine would be in active operation by the end of March. He said—

Large reserves of copper rock were developed just prior to the depression, these reserves amounting to approximately 2,000,000 tons, and an additional 4,000,000 tons partly developed are intact in the lower levels of the mine. * * *

Mine production of gold, silver, and copper in Michigan, 1932–36 [1]

Year	Gold (fine ounces)	Silver (fine ounces)	Copper			Concentrate ("mineral")		Ore ("rock") (short tons)
			Pounds	Yield		Pounds	Yield (percent copper)	
				Pounds per ton of ore ("rock")	Percent			
1932		71,408	54,396,108	47.6	2.38	79,753,030	68.2	1,142,775
1933	9.67	[2] 125,926	46,853,130	67.2	3.36	68,999,174	67.9	[3] 697,158
1934	58.63	[2] 529	48,215,859	68.9	3.44	70,102,754	68.8	[4] 700,055
1935		4,219	[5] 64,108,689	[5] 46.6	[5] 2.33	[6] 95,509,256	[6] 67.1	[7] 1,376,803
1936			[5] 95,968,019	[5] 29.8	[5] 1.49	[6] 141,166,376	[6] 68.0	[7] 3,225,600

[1] Figures based on actual recovery of copper from "mineral" smelted and estimated recovery from "mineral" not smelted during year.
[2] According to Bureau of the Mint.
[3] Excludes 200 tons of old tailings cyanided for recovery of gold and silver.
[4] Excludes 800 tons of ore amalgamated for recovery of gold and silver.
[5] Includes copper from sands.
[6] Includes "mineral" from sands.
[7] Includes sands.

Value of silver and copper produced in Michigan mines, 1932–36

Year	Silver	Copper		Total	Year	Silver	Copper		Total
		Total	Per ton of ore ("rock")				Total	Per ton of ore ("rock")	
1932	$20,137	$3,426,955	$3.00	$3,447,092	1935	$3,032	$5,321,021	$3.86	$5,324,053
1933	[1] 44,074	2,998,600	4.30	3,042,674	1936		8,829,058	2.74	8,829,058
1934	[1] 342	3,857,269	5.51	3,857,611					

[1] According to Bureau of the Mint.

The following data are abstracted from reports of the companies to their stockholders.

Production of copper by the Calumet & Hecla Consolidated Copper Co. from the Conglomerate and Ahmeek mines in 1936 amounted to 59,315,000 pounds at an average cost sold (not including depreciation and depletion) of 6.20 cents a pound. The Lake Linden reclamation plant was operated continuously and at maximum efficiency. Production totaled 19,167,000 pounds of copper at an average cost sold (not including depreciation and depletion) of 4.51 cents a pound. In 1935 the Conglomerate mine produced 36,330,800 pounds of copper at an average cost of 6.07 cents, and the reclamation plant produced 9,118,000 pounds at an average cost of 4.80 cents. The average selling price was 9.80 cents a pound in 1936 compared with 8.89 cents in 1935. The Conglomerate lode, which has been operated almost continuously for 70 years and has been the principal producing unit of the company, was nearing exhaustion at the end of the year; its expected life was only 12 to 14 months. The Tamarack reclamation plant, idle since November 1930, was being reconditioned, and production was expected to begin early in the spring of 1937. The tonnage of material remaining to be treated at this plant was estimated to be sufficient for 5 years of normal operation. The tonnage remaining at the Lake Linden reclamation plant was expected to be sufficient for 7 years of normal operation. The operations of the Lake Linden plant for 1936 and from the beginning of its operations through 1936 were as follows:

Operations at the Calumet & Hecla reclamation plant at Lake Linden in 1936 and for the entire period of its operation

	1936	Since starting
Quantity treated .... short tons	1,547,000	22,122,000
Assay headings .... percent	0.720	0.714
Assay tailings .... do	.098	.144
Refined copper produced .... pounds	19,167,000	252,848,000
Refined copper produced per ton treated .... do	12.39	11.43

Of the total production in 1936, 4,352,000 pounds were from table treatment following grinding, 12,218,000 pounds from leaching, and 2,597,000 pounds from flotation.

The Calumet mill stamped 473,338 tons of Conglomerate rock and the Ahmeek mill 884,447 tons of Kearsarge lode rock. From current production and stock the smelter treated 55,602 tons of concentrates which yielded 72,490,512 pounds of copper.

Work of the company in the Ishpeming gold area continued and was directed principally toward efforts to discover the size and grade

of the old Ropes ore body and to see whether other ore bodies occur along the shear zone in which it lies. Indications were that there is a good possibility that the ore body contains about 1 million tons of ore averaging 0.13 ounce of gold and 0.70 ounce of silver to the ton. Dividends totaling $1,504,126.50 were paid during the year, the first since 1930.

Copper production by the Copper Range Co. in 1936 was not greatly in excess of that in 1935. The Champion mine produced 17,486,019 pounds of copper compared with 16,759,889 pounds in 1935. The average cost per pound increased 0.61 cent, while the average sales price increased 0.91 cent. Through a merger agreement the Copper Range Co. acquired all the assets of C. G. Hussey & Co., as of December 31, 1936. Owing to a substantial increase in the quantity of fabricated copper products produced and sold, the Hussey company had to purchase copper from outside sources. At the close of 1936 the Copper Range Co. withdrew from the outside market and in the future will ship its entire output of copper to the Hussey plant. The operations of the company for 5 years are shown in the following table.

Copper produced by the Champion mine of the Copper Range Co., 1932–36

Year	Rock stamped	Copper produced	Yield per ton	Cost per pound [1]	Price received
	Short tons	*Pounds*	*Pounds*	*Cents*	*Cents*
1932	291, 265	12, 188, 578	41. 847	8. 646	6. 0
1933	203, 940	12, 167, 130	59. 66	7. 51	7. 46
1934	241, 175	13, 929, 859	57. 76	8. 69	8. 55
1935	280, 500	16, 759, 889	57. 56	8. 26	8. 68
1936	320, 815	17, 486, 019	54. 51	8. 87	9. 59

[1] Excludes depreciation and depletion.

Missouri.—The following tables show the production of lead and zinc in southwestern Missouri and the tenor of ore ("dirt") and concentrates from Missouri.

As only one large tailing mill was operated in 1936 and 1935, the Bureau of Mines is not at liberty to give detailed separate recoveries from old tailings. The 460,700 tons of crude ore milled in southwestern Missouri in 1936 yielded 0.64 percent in lead concentrates and 6.91 percent in zinc concentrates. Some slag was shipped to the Ozark Mining & Smelting Co. at Coffeyville, Kans., from the old Granby smelter.

Mine production of lead and zinc in southwestern Missouri, 1935–36

Year	Lead concentrates				Zinc concentrates				Metal content [1]			
	Galena		Carbonate		Sphalerite		Silicate		Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935	490	$19, 600	345	$10, 350	13, 020	$371, 980	1, 400	$20, 561	552	$44, 160	7, 263	$639, 144
1936	2, 340	113, 912	294	10, 497	34, 068	1. 085, 455	621	10, 762	2, 006	184, 552	18, 665	1, 866, 500

[1] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and old tailings treated and concentrates produced in southwestern Missouri, 1933–36

	1933	1934	1935 [1]	1936 [2]
Total ore and old tailings treated short tons	170,800	425,500	554,300	871,200
Total concentrates in ore:				
Lead percent	0.81	0.30	0.15	0.27
Zinc do	4.51	3.26	2.60	3.95
Metal content of ore:				
Lead do	.60	.22	.10	.20
Zinc do	2.51	1.88	1.49	2.40
Average lead content of galena concentrates do	72.3	78.0	73.7	77.0
Average lead content of lead carbonate concentrates do	60.6	63.4	60.0	63.0
Average zinc content of sphalerite concentrates do	59.8	59.5	59.4	61.1
Average zinc content of silicates and carbonates do	39.4	39.3	38.0	40.1
Average value per ton:				
Galena concentrates	$37.89	$36.40	$40.00	$50.53
Lead carbonate concentrates	31.76	27.64	30.00	35.70
Sphalerite concentrates	27.85	27.26	28.57	32.20
Zinc silicates and carbonates	15.01	14.53	14.62	17.33

[1] Includes 364,000 tons of old tailings and slimes yielding 16 tons of galena concentrates and 5,840 tons of 58.3-percent sphalerite concentrates.
[2] Includes 408,700 tons of old tailings and slimes yielding 5 tons of galena concentrates and about 6,200 tons of 59.8-percent sphalerite concentrates.

Tenor of lead ore and concentrates in southeastern Missouri disseminated-lead district, 1933–36

	1933	1934	1935	1936
Total lead ore short tons	2,490,000	2,989,500	3,082,300	3,418,800
Galena concentrates in ore percent	4.67	4.07	4.26	4.26
Zinc content of ore do				
Average lead content of galena concentrates do	73.7	75.06	73.3	76.0
Average value per ton of galena concentrates	$35.12	$37.00	$53.25	$50.00
Average zinc content of sphalerite concentrates percent				45.0
Average value per ton of sphalerite concentrates				$18.00

Mine shipments of lead and zinc concentrates in southeastern and central Missouri, 1907–36

Year	Lead concentrates (galena)		Zinc concentrates			
			Sphalerite		Carbonate and silicate	
	Short tons	Value	Short tons	Value	Short tons	Value
1907–32	6,518,108	$413,325,195	36,234	$1,151,055	10,285	$233,534
1933	116,226	4,081,486				
1934	121,781	4,505,900				
1935	131,405	6,998,116				
1936	145,575	7,278,750	112	2,016		

The value of the silver, copper, lead, and zinc shipped from Missouri mines was $12,192,221 in 1936, compared with $8,523,659 in 1935. No silver was recovered from copper ores in 1936 or 1935, but silver skimmings from lead refining yielded 163,720 ounces of silver in 1936 and 110,551 ounces in 1935; in addition, lead ore yielded 382,000 pounds of copper in 1936 and 67,660 pounds in 1935. The quantity of recovered lead increased to 110,428 tons in 1936 from 97,493 tons in 1935 and that of recovered zinc to 18,709 tons in 1936 from 7,263 tons in 1935.

Shipments of lead concentrates (of which only 294 tons were lead carbonate) were 148,209 tons in 1936, compared with 132,240 tons in

1935. Of the total in 1936, 145,575 tons were shipped from mines in southeastern Missouri, compared with 131,405 tons in 1935. The average lead content of the galena from southeastern Missouri in 1936 was 76 percent, and the recovered lead content was 108,422 tons, compared with 96,941 tons in 1935. Small shipments of sphalerite, the first in several years, were also made from southeastern Missouri in 1936; these low-grade concentrates yielded 44 tons of zinc. Shipments of lead concentrates from southwestern Missouri mines comprised 2,340 tons of galena and 294 tons of lead carbonate in 1936, compared with 490 and 345 tons, respectively, in 1935. The comparatively large increase in galena was due to increase in the Oronogo camp.

The total value given for all concentrates is based on actual receipts by the sellers and not on quoted prices. In 1936, as in 1935, the quoted price for galena concentrates was that paid for medium-size lots, and sellers of larger than carload lots were paid $1 to $2 a ton above the quoted prices.

The quoted price for 80-percent galena concentrates for the first 8 weeks of 1936 was $47; it was $50 from March until October, when it reached $54. The price rose $3 a ton early in November, and advances of $1 in each of the next 2 weeks increased it to $59, where it remained until about December 12. It advanced then to $64 and again to $70 during the last 10 days of 1936.

The quoted price of sphalerite concentrates in 1936 opened at $32 and was steady at that price for 27 weeks, gradually declining to $30.50 early in July. It was $31 from the last week in July to the end of August, rose to $31.50 the first week in September, where it held for 10 weeks, reached $32 the second week in November, and was $32.50 the last week in that month. On December 19 the price was raised to $35, where it remained for the rest of the year.

No prices were quoted in 1936 for lead carbonate ore or for zinc silicate. At flat rates the average price received by sellers was $35.70 a ton for lead carbonate and $17.33 for zinc silicate. There was an active demand for milled zinc silicate, but the production remained small (641 tons in 1936), and few new properties that recovered such ore were opened.

The foregoing quoted prices apply to all mines in the Tri-State or Joplin region of Kansas, Missouri, and Oklahoma.

There was considerable drilling in southwestern Missouri in 1936, and leasing was active during the latter part of the year. Old mining lands were purchased and held pending expected advances in the prices of lead and zinc. Activity was pronounced in the Oronogo, north Webb City, Carthage, Spurgeon, Racine, and Waco camps. Little work, other than drilling, was done at Aurora, Granby, Spring City, Alba, Neck City, or Duenweg. Nearly all the crude ore produced was mined near Carthage, Waco, and Oronogo, and most of the zinc tailings treated came from near Joplin. About 75 percent of the lead was from the Oronogo camp, which also produced more than 22,000 tons of sphalerite from crude ore shipped to the Central mill of the Eagle-Picher Mining & Smelting Co. in Oklahoma.

The estimated flotation product from ore mined in southwestern Missouri in 1936 was 20,270 tons of sphalerite and 500 tons of galena. Flotation sphalerite concentrates from Missouri ores in 1935 were only 4,520 tons. The mills in southeastern Missouri made 64,671 tons of flotation galena concentrates in 1936 and 53,488 tons in 1935.

Of about 427,000 tons of sphalerite shipped from the Tri-State region, it is estimated that the flotation concentrates amounted to 198,826 tons in 1936 compared with 159,000 tons in 1935. Since the extension of flotation the average grade of the galena concentrates has declined several points, whereas that of the sphalerite has increased slightly. Some of the galena from the jigs and tables has a lead content of 80 percent (and above), but the flotation galena probably does not average more than 70 percent. The small quantity of galena produced at tailing mills is of low grade, averaging from 48 to 70 percent. About 50 mines, large and small, were worked in southwestern Missouri in 1936; only 10 mills were operated, and the greater part of the ore mined was treated in Oklahoma.

The largest shippers of sphalerite concentrates in 1936 were as follows: Missouri Mining Co., operating a large tailing plant at Chitwood; D. & C. Mining Co. and Denny Mining Co. at Carthage; Playter Mining Co. at Waco; Spurgeon Mining Co. at Spurgeon; and the Burton Mining Co. near Joplin. The Oronogo Mutual Mining Co., Hickman Mining Co., and Webb City Lead & Zinc Co. shipped an aggregate of more than 368,000 tons of crude ore by rail to the Central mill in Oklahoma, and other properties are preparing to make shipments to that plant. The Little Phoebe Mining Co. shipped some sphalerite from Wentworth late in 1936. The largest shipper of zinc silicate was Pilant & Co. at Granby; small shipments were made from Racine and Aurora.

The old Oronogo Circle mine has been dewatered, and some ore is being stripped in the cave-in. Preparations are being made to unwater old properties at Waco, Neck City, Webb City, and Belville.

The lead ore (3,418,800 tons) mined in 1936 in the southeastern Missouri disseminated-lead district yielded 4.26 percent in galena concentrates averaging 76 percent lead. Very little galena was shipped by small gougers and prospectors. The mines and mills of the St. Joseph Lead Co. have a daily capacity of about 17,000 tons. Four mills were active in 1936. The Federal mine and mill were operated 273 days and the Leadwood, Bonne Terre, and Desloge plants about 144 days.

Oklahoma.—About 40 mills, large and small, were operating in Oklahoma at the end of 1936. There were at least 40 operators who did not mill their own crude ore but shipped it to custom concentrating plants or central mills. The Tri-State Zinc & Lead Ore Producers Association reported that at the end of the year stocks of sphalerite at mines in the Tri-State region had been reduced to 11,028 tons and those of galena to 6,808 tons. Most of these stocks were held by two or three large operators who sold substantial quantities early in 1937, so that the stocks of zinc concentrates are only a little larger than the weekly purchases.

Few companies segregate their coarse galena from the flotation galena, but it is estimated that the flotation galena produced in Oklahoma in 1936 was about 6,800 tons and the flotation sphalerite about 149,000 tons. A large part of the concentrates from the tailing mills and from the central mills is a flotation product. The tailing mills produce very small quantities of low-grade galena, and the flotation galena at the large mills treating crude ore is of lower grade than the jig and table galena; on the other hand, much of the flotation sphalerite made is of higher grade than the coarse concentrates. This

has resulted in reducing the lead content of the galena and increasing that of the sphalerite concentrates.

The capacity of some of the larger mills was increased in 1936, but few new mills to treat crude ore were built, little exploration was done, and only a few churn drills were operated by the larger companies. The number of drills operated in the Tri-State region in 1936 probably did not exceed 20; the total number had increased to 50 by April 1937. Higher prices probably will result in increased drilling in the Melrose section of the western part of the region. At many old mines the ore is coming from pillars and other clean-ups, and if present production is to be continued development must be done in 1937.

Nearly 3,180,000 tons more old tailings than crude ore were treated in Oklahoma in 1936, and the output of the tailing mills in the Tri-State region was more than 113,000 tons.

The mine shipments of lead and zinc concentrates, the recovered metal contents, and the tenor of lead and zinc ores and tailings are given for Oklahoma in the following tables:

Mine shipments of lead and zinc in Oklahoma, 1935–36

Year	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Metal content [1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935	30,790	$1,329,656	246,131	$7,047,052	23,405	$1,872,400	129,763	$11,419,144
1936	34,833	1,735,732	244,740	7,628,448	25,427	2,339,284	129,175	12,917,500

[1] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore, old tailings, and slimes milled and concentrates produced in Oklahoma, 1935–36

	1935		1936	
	Crude ore	Old tailings and slimes	Crude ore	Old tailings and slimes
Total ore, etc., milled ... short tons	2,757,200	4,490,100	2,953,000	6,132,600
Total concentrates shipped:				
Galena ... do	30,485	305	33,356	477
Sphalerite ... do	184,979	61,152	171,784	72,956
Ratio of concentrates to ore, etc.:				
Lead ... percent	0.89	------------	1.01	0.001
Zinc ... do	6.24	1.36	5.80	1.19
Metal content of ore, etc.:				
Lead ... do	.69	------------	.77	------------
Zinc ... do	3.80	.81	3.49	.71
Average lead content of galena concentrates ... do	77.6	63.6	77.0	61.5
Average zinc content of sphalerite concentrates ... do	60.0	59.8	60.2	59.4
Average value per ton:				
Galena concentrates	$43.30	$26.54	$51.39	$45.04
Sphalerite concentrates	28.82	28.05	31.58	30.21

Mine production of lead and zinc concentrates in Oklahoma, 1891–1936, by districts

District	Lead concentrates (mainly galena)		Zinc concentrates			
			Sphalerite		Zinc silicate and carbonate	
	Short tons	Value	Short tons	Value	Short tons	Value
Davis			558	$27,399	899	$24,592
Miami [1]	1,173,527	$97,594,520	6,617,160	260,536,293	164	2,692
Peoria	2,639	127,163	220	8,289	3,120	79,649
	1,176,166	97,721,683	6,617,938	260,571,981	4,183	106,933

[1] Including Quapaw and Sunnyside.

There was no output from the Peoria camp in 1936 or 1935. The output from the old Commerce (Hattenville) camp in 1936 was about 290 tons of galena and 833 tons of sphalerite, mainly from the leases of the Commerce Mining & Royalty Co. The producers in the Quapaw-Sunnyside area were the Kansas & Oklahoma Mining Trust, Atlas Milling Co., Mission Mining & Royalty Co., Century Zinc Co. (Scott), and St. Louis Smelting & Refining Co. (No. 4). In the central and western parts of the Oklahoma portion of the Tri-State region the following mills were operated partly on ore and partly on tailings: Evans Wallower Lead Co. (No. 7), Skelton Lead & Zinc Co., and Lawyers Lead & Zinc Co. The following mills treated tailings only: Cardin Mining & Milling Co. (Nos. 1, 2, and 3), Commerce Mining & Royalty Co. (two mills), Britt Mining Co., Tri-State Zinc Co. (two mills), Youngman Milling Co. (Ritz), Andrews Mining & Milling Co. (Whitebird), Cortez King Brand Mining Co., C. Y. Semple (Huttig), and W. H. Aul Mining Co. (Howe). The Eagle-Picher Mining & Smelting Co. (Central mill) treated more crude ore than any other mill in the district; its total and that of the Bird Dog, See Sah, and Blue Goose mills of the Commerce Mining & Royalty Co. aggregated more than half of all the crude ore milled in Oklahoma in 1936. Other large outputs were made by the Evans Wallower Lead Co. (No. 4), Interstate Zinc & Lead Co. (Woodchuck), Rialto Mining & Royalty Co., United Zinc Smelting Corporation, Admiralty Zinc Co., Mary M. Mining Co., Velie Mines Corporation (Velie, Wilson, and Farmington mines), Guaranty Mining & Royalty Co., Indian Mining & Milling Co., Canadian Mining & Milling Co., Meteor Four Mine, Black Mining Co., Lavrion Mining Co., and Baxter Mining & Development Co. All the Admiralty Zinc Co. leases were purchased by the Mary M. Mining Co., and early in 1937 all the latter company's property was acquired by Eagle-Picher Mining & Smelting Co.

Some of the larger Oklahoma shippers to the Central mill of the Eagle-Picher company were the Davis Big Chief Mining Co., Craig Mining Co., Cameron & Henderson, Blue Eagle Mining Co., F. H. Nesbitt, J. Dryer, W. H. Mining Co., Henderson Mining Co., and Loyce June Mining Co. The Commerce Mining & Royalty Co. milled crude ore from many of its own properties at the Bird Dog mill as well as ore received from the B. H. & W. Mining Co. (S. S. & G. and Anna Beaver mines) and other mines. The capacity of the Bird Dog mill has been increased one-third, and that of the Central mill (5,500 tons per day) is to be increased to more than 9,000 tons.

Wisconsin.—The output of both galena and sphalerite concentrates in Wisconsin increased in 1936. The grade of the raw zinc concentrates, however, was much lower than in 1935 so that the recovered zinc content declined 797 tons. Practically all the raw zinc concentrates were shipped to the roasting plant of the Vinegar Hill Zinc Co. at Cuba City.

The Vinegar Hill Zinc Co. worked the Blockhouse mine 159 days, the Mullen No. 2 mine 134 days, and the Doyle-Harty mine 235 days; it produced most of the zinc and lead concentrates. The Thomas Mining Co. worked the Crawford mine 129 days, and the Meloy & Baker Mining Co. operated the De Rocher mine 203 days. The O. H. & S. Mining Co. mine near Platteville was worked 60 days, and the Hill mine at Linden 120 days. Other producers were the Doyle & Murray Mining Co. at Shullsburg and the George Baker mine at Benton.

Small lots of concentrates were shipped from various properties, and some stocked sphalerite made prior to 1936 was shipped by the McKinlay Mining Co. of Dodgeville.

The mining and milling methods at the Doyle mine at Shullsburg are described in a recent publication of the Bureau of Mines.[3]

Mine production of lead and zinc in Wisconsin, 1935–36

Year	Lead concentrates		Zinc concentrates (sphalerite)		Metal content [1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935	398	$16,963	33,027	$379,262	286	$22,880	8,923	$785,224
1936	1,277	61,198	38,276	400,899	904	83,168	8,126	812,600

[1] In calculating the metal content of the ores from assays allowance has been made for roasting and smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and concentrates produced in Wisconsin, 1933–36

	1933	1934	1935	1936
Total ore ..... short tons	256,400	308,600	236,000	284,800
Total concentrates in ore:				
Lead ..... percent	0.30	0.11	0.17	0.45
Zinc ..... do	10.01	10.20	14.00	13.44
Metal content of ore:				
Lead ..... do	.22	.08	.12	.32
Zinc ..... do	3.60	3.61	4.85	3.61
Average lead content of galena concentrates ..... do	72.5	70.3	73.3	72.2
Average zinc content of sphalerite concentrates ..... do	35.7	35.4	34.6	27.0
Average value per ton:				
Galena concentrates	$40.86	$37.02	$42.62	$48.08
Sphalerite concentrates	12.85	11.62	11.48	10.47

[3] Agnew, Wing G., Underground Mill at the Doyle Mine, Shullsburg, Wis.: Inf. Circ. 6908, Bureau of Mines, 1936, 4 pp.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN IDAHO

(MINE REPORT)

By Paul Luff [1]

SUMMARY OUTLINE

The output of gold, silver, copper, lead, and zinc from mines in Idaho in 1936, in terms of recovered metals, was 80,291.40 fine ounces of gold, 14,537,530 fine ounces of silver, 2,954,000 pounds of copper, 182,678,000 pounds of lead, and 98,200,000 pounds of zinc. This output compares with a production in 1935 of 83,823.06 ounces of gold, 10,240,953 ounces of silver, 2,095,867 pounds of copper, 158,040,250 pounds of lead, and 62,105,568 pounds of zinc. There were 281 lode mines and 828 placers producing in 1936 compared with 289 lode mines and 1,079 placers in 1935.

Since 1863 the output of the five metals in Idaho has been as follows: Gold, 7,030,826.39 fine ounces; silver, 379,546,495 fine ounces; copper, 83,902 tons; lead, 5,021,437 tons; and zinc, 577,904 tons. The total value of this output has been $1,053,213,440.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the prices given in the table that follows. Gold in 1932 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1837, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95 per ounce, the yearly average weighted United States Government price [2]; and in 1935 and 1936 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1932 and 1933 is the average New York price for bar silver; in 1934, the Treasury buying price ($0.64646464+ per ounce) for newly mined silver; and in 1935 and 1936, the yearly average weighted Treasury buying price for newly mined silver. The copper, lead, and zinc prices are weighted yearly averages of all grades of primary metal sold by producers.

[1] Assisted by Jeannette Froiseth.

[2] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25-28.

Prices of gold, silver, copper, lead, and zinc, 1932–36

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[1] $20.67+	$0.282	$0.063	$0.030	$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050

[1] $20.671835. [2] $0.64646464.

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1932–36, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1932	178	280	1,032,853	46,885.39	$969,207	6,716,968	$1,894,185
1933	188	334	1,190,851	64,592.23	1,650,977	6,987,960	2,445,786
1934	291	1,172	1,287,182	84,817.20	2,964,361	7,394,143	4,780,052
1935	289	1,079	1,520,945	83,823.06	2,933,807	10,240,953	7,360,685
1936	281	828	1,807,530	80,291.40	2,810,199	14,537,530	11,259,317

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1932	1,143,381	$72,033	144,235,067	$4,327,052	20,504,234	$615,127	$7,877,604
1933	1,562,234	99,983	148,726,701	5,502,888	41,935,977	1,761,311	11,460,945
1934	1,531,625	122,530	142,648,216	5,277,984	49,598,651	2,132,742	15,277,669
1935	2,095,867	173,957	158,040,250	6,321,610	62,105,568	2,732,645	19,522,704
1936	2,954,000	271,768	182,678,000	8,403,188	98,200,000	4,910,000	27,654,472

Gold and silver produced at placer mines in Idaho, 1932–36, in fine ounces, in terms of recovered metals

Year	Sluicing		Dry-land dredges [1]		Floating (bucket) dredges		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1932	4,161.28	857	(2)	(2)	[2] 8,278.40	[2] 2,969	12,439.68	3,826
1933	5,147.97	1,164	781.16	149	17,360.77	5,930	23,289.90	7,243
1934	8,155.62	2,350	3,248.70	593	15,852.05	5,585	27,256.37	8,528
1935	8,134.07	2,641			23,616.96	9,544	31,751.03	12,185
1936	8,282.46	1,473	49.15	19	26,098.19	9,661	34,429.80	11,153

[1] Dragline and power-shovel excavators with sluices or special amalgamators.
[2] Figures for floating dredges include those for dry-land dredges; separate figures not available.

Gold.—The output of recoverable gold in Idaho was 80,291.40 fine ounces in 1936, a decrease of 4 percent from the output in 1935. Gold produced from lode mines amounted to 45,861.60 ounces, a decrease of 6,210.43 ounces, and gold recovered at placers amounted to 34,429.80 ounces, an increase of 2,678.77 ounces. Most of the gold from placers came from the Warren and Boise Basin districts where dredges were operated. Twelve floating (bucket) dredges recovered 26,098.19 ounces of gold in 1936 compared with nine in 1935 which recovered 23,616.96 ounces. Siliceous gold ore yielded 42,176.01

ounces of gold (53 percent of the total) in 1936, a decrease of 6,028.02 ounces; placers yielded 43 percent. Nearly 66 percent of the gold from lode and placer mines was recovered from 12 mines in Boise, Elmore, Idaho, Owyhee, and Valley Counties. The Meadow Creek mine of the Yellow Pine Co. at Stibnite was the largest producer of gold in Idaho in 1936; it was followed by the Golden Anchor mine at Burgdorf, the Wharton property (dredge) at Centerville, the Gold Hill mine at Quartzburg, the Idaho Gold Dredging Co. and the Baumhoff-Fisher Co. (dredge) at Warren, the Boise-Rochester mine at Atlanta, the Jordan Creek dredge at De Lamar, the Gnome mine near Elk City, the Moores Creek Dredging Co. at Idaho City, the Orogrande-Frisco property near Orogrande, and the Grimes Co. (dredge) at Pioneerville. The Boise-Rochester mine, the largest producer of gold in Idaho from 1932 to 1935, inclusive, was closed in June 1936 and sold to The Sawtooth Co.

Silver.—The output of recoverable silver in Idaho was 14,537,530 fine ounces in 1936, the largest output ever recorded in the State and an increase of 42 percent over the output in 1935. Idaho has been the largest producer of silver in the United States since 1933; Utah and Montana rank next. Silver ore yielded nearly 69 percent of the total silver from Idaho in 1936, lead-zinc ore 19 percent, and lead ore 11 percent. The production of silver from silver ore increased from 6,310,726 ounces in 1935 to 9,991,204 ounces in 1936; silver output from lead-zinc ore and lead ore also increased. Eleven mines produced 96 percent of the silver output of the State in 1936. The Sunshine mine, the largest producer of silver in the United States, produced nearly 63 percent of the State output; it was followed by the Hecla at Burke, Bunker Hill at Kellogg, Morning at Mullan, Crescent on Big Creek, Triumph near Ketchum, Page west of Kellogg, Star near Burke, Gold Hunter at Mullan, Clayton at Clayton, and Hewer near Lakeview in Bonner County.

Copper.—The output of recoverable copper in Idaho was 2,954,000 pounds in 1936 compared with 2,095,867 pounds in 1935, an increase of 41 percent. More than half of the copper produced in Idaho in 1936 was recovered from concentrating silver ore from the Sunshine mine on Big Creek, Shoshone County; most of the remainder was recovered from concentrating lead-zinc ore from the Bunker Hill, Morning, and Triumph mines.

Lead.—The output of recoverable lead in Idaho was 182,678,000 pounds in 1936, compared with 158,040,250 pounds in 1935, an increase of nearly 16 percent but less than the average annual output (213,324,724 pounds) for the decade 1927–36. Lead-zinc ore yielded 71 percent of the total lead in 1936, and lead ore 28 percent. Lead from lead-zinc ore increased 18,412,105 pounds and from lead ore 5,535,044 pounds. Ten mines in 1936 produced 96 percent of the total lead; the combined output of the three largest—Bunker Hill, Morning, and Hecla—was 77 percent of the total. In order of output the 10 leading producing mines were: Bunker Hill, Morning, Hecla, Page, Star, Triumph, Gold Hunter, Sidney, Clayton, and Hope; all except the Triumph, Clayton, and Hope mines are in the Coeur d'Alene region, Shoshone County. Considerable lead was also produced from the Warm Springs district in Blaine County, Bay Horse district in Custer County, Pend d'Oreille district in Bonner County, and Texas district in Lemhi County.

Zinc.—The output of recoverable zinc in Idaho in 1936 was 98,200,000 pounds, the largest ever recorded in the State and an increase of 36,094,432 pounds over the production in 1935. The unusually large gain was due chiefly to the increase in output of lead-zinc ore from the Star mine and to the resumption of operations at the Triumph mine near Ketchum, Blaine County. Substantial gains in the production of zinc were also made at the Bunker Hill, Sidney, Morning, and North Star mines. Lead-zinc ore yielded 99 percent of the total in 1936 and lead ore nearly all the remainder. There was an increase of 35,755,062 pounds in zinc from lead-zinc ore and 342,533 pounds from lead ore. Seven mines, each producing more than 2,000,000 pounds of zinc in 1936, yielded 95 percent of the total. The Morning mine of the Federal Mining & Smelting Co. continued as the largest zinc producer in Idaho, followed by the Bunker Hill, Star, Triumph, Sidney, Frisco, and Page mines.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1935–36, by counties, in terms of recovered metals

County	Mines producing			Ore (short tons)	Gold						Silver	
					Lode		Placer		Total		Lode	
	Lode	Placer	Total		Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
1935												
Ada	3	22	25	426	23.97	$839	145.34	$5,087	169.31	$5,926	14	$10
Adams	2	1	3	883	1,291.06	45,187	.94	33	1,292.00	45,220	757	544
Benewah		6	6				26.20	917	26.20	917		
Bingham		1	1				2.20	77	2.20	77		
Blaine	28	1	29	1,001	242.80	8,498	1.86	65	244.66	8,563	12,071	8,676
Boise	33	152	185	36,162	7,932.60	277,641	5,043.77	176,532	12,976.37	454,173	54,717	39,328
Bonner	6		6	9,327	17.40	609			17.40	609	56,103	40,324
Bonneville		5	5				127.46	4,461	127.46	4,461		
Boundary	3	1	4	23	2.80	98	.34	12	3.14	110	409	294
Butte	3		3	76	.60	21			.60	21	1,504	1,081
Camas	5	5	10	1,551	324.20	11,347	1,190.00	41,650	1,514.20	52,997	4,512	3,243
Canyon		2	2				2.66	93	2.66	93		
Clearwater	1	80	81	5	3.60	126	2,272.86	79,550	2,276.46	79,676		
Custer	23	15	38	11,122	229.80	8,043	92.60	3,241	322.40	11,284	59,655	42,877
Elmore	14	42	56	81,413	19,814.20	693,497	194.43	6,805	20,008.63	700,302	65,020	46,733
Gem	4	8	12	35	45.80	1,603	15.03	526	60.83	2,129	139	100
Gooding		7	7				5.94	208	5.94	208		
Idaho	46	406	452	71,013	8,253.60	288,876	18,727.66	655,468	26,981.26	944,344	10,695	7,687
Jerome		20	20				110.74	3,876	110.74	3,876		
Latah		16	16				86.77	3,037	86.77	3,037		
Lemhi	49	85	134	15,476	2,648.60	92,701	625.57	21,895	3,274.17	114,596	12,811	9,208
Minidoka		3	3				7.06	247	7.06	247		
Nez Perce	1	16	17	1	2.00	70	29.26	1,024	31.26	1,094	14	10
Owyhee	32	33	65	372	197.40	6,909	1,942.00	67,970	2,139.40	74,879	6,521	4,687
Power		11	11				73.60	2,576	73.60	2,576		
Shoshone	28	76	104	1,237,244	1,979.80	69,293	734.20	25,697	2,714.00	94,990	9,892,775	7,110,432
Twin Falls		37	37				125.40	4,389	125.40	4,389		
Valley	6	24	30	53,855	9,045.20	316,582	89.74	3,141	9,134.94	319,723	29,177	20,971
Washington	2	4	6	960	16.60	581	77.40	2,709	94.00	3,290	21,874	15,722
	289	1,079	1,368	1,520,945	52,072.03	1,822,521	31,751.03	1,111,286	83,823.06	2,933,807	10,228,768	7,351,927

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1935–36, by counties, in terms of recovered metals—Continued

County	Mines producing			Ore (short tons)	Gold						Silver	
					Lode		Placer		Total		Lode	
	Lode	Placer	Total		Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
1936												
Ada	2	17	19	41	10.80	$378	644.00	$22,540	654.80	$22,918	9	$7
Adams	5		5	896	887.40	31,059			887.40	31,059	408	316
Benewah		4	4				16.00	560	16.00	560		
Bingham		1	1				2.00	70	2.00	70		
Blaine	27	1	28	39,663	487.80	17,073	1.20	42	489.00	17,115	318,195	246,442
Boise	32	137	169	43,823	9,288.60	325,101	12,386.60	433,531	21,675.20	758,632	45,889	35,541
Bonner	8		8	19,364	46.20	1,617			46.20	1,617	141,605	109,673
Bonneville		5	5				141.60	4,956	141.60	4,956		
Boundary	1		1	153							3,104	2,404
Butte	2		2	81							914	708
Camas	5	1	6	831	247.80	8,673	456.40	15,974	704.20	24,647	1,286	996
Canyon		1	1				.80	28	.80	28		
Cassia	1		1	2	.60	21			.60	21	5	4
Clearwater		75	75				1,629.40	57,029	1,629.40	57,029		
Custer	24	16	40	26,153	277.40	9,709	79.80	2,793	357.20	12,502	129,947	100,644
Elmore	23	41	64	29,965	4,104.60	143,661	244.40	8,554	4,349.00	152,215	27,410	21,229
Gem	5	8	13	121	114.40	4,004	68.80	2,408	183.20	6,412	186	144
Gooding		6	6				10.00	350	10.00	350		
Idaho	50	229	279	121,053	15,656.40	547,974	13,303.20	465,612	28,959.60	1,013,586	24,022	18,605
Jerome		39	39				196.00	6,860	196.00	6,860		
Latah		11	11				47.00	1,645	47.00	1,645		
Lemhi	36	57	93	24,293	4,276.40	149,674	697.60	24,416	4,974.00	174,090	29,357	22,737
Nez Perce		7	7				29.00	1,015	29.00	1,015		
Owyhee	25	22	47	1,173	336.60	11,781	3,642.60	127,491	3,979.20	139,272	7,091	5,492
Power		6	6				51.20	1,792	51.20	1,792		
Shoshone	25	71	96	1,454,987	1,965.60	68,796	488.80	17,108	2,454.40	85,904	13,740,133	10,641,733
Twin Falls		58	58				103.80	3,633	103.80	3,633		
Valley	8	15	23	44,109	8,146.20	285,117	189.60	6,636	8,335.80	291,753	34,102	26,412
Washington	2		2	822	14.80	518			14.80	518	22,714	17,592
	281	828	1,109	1,807,530	45,861.60	1,605,156	34,429.80	1,205,043	80,291.40	2,810,199	14,526,377	11,250,679

County	Silver—Continued				Copper		Lead		Zinc		Total value
	Placer		Total								
	Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
1935—Continued											
Ada	18	$13	32	$23							$5,949
Adams			757	544	759	$63	525	$21			45,848
Benewah											917
Bingham											77
Blaine			12,071	8,676	2,578	214	88,475	3,539	79,864	$3,514	24,506
Boise	1,383	994	56,100	40,322	2,651	220	17,600	704			495,419
Bonner			56,103	40,324	2,916	242	431,075	17,243	7,863	646	58,764
Bonneville	4	3	4	3							4,464
Boundary			409	294	24	2	16,125	645			1,051
Butte			1,504	1,081	530	44	5,850	234			1,380
Camas	693	498	5,205	3,741	361	30	9,425	377			57,145
Canyon											93
Clearwater	640	460	640	460							80,136
Custer	46	33	59,701	42,910	46,410	3,852	544,925	21,797			79,843
Elmore	36	26	65,056	46,759	7,072	587					747,648
Gem	7	5	146	105			850	34			2,268
Gooding											208
Idaho	7,214	5,185	17,909	12,872	1,072	89	6,350	254			957,559
Jerome	7	5	7	5							3,881
Latah	11	8	11	8							3,045
Lemhi	85	61	12,896	9,269	33,133	2,750	277,125	11,085			137,700
Minidoka											247
Nez Perce	4	3	18	13	72	6					1,113
Owyhee	1,856	1,334	8,377	6,021			450	18			80,918
Power	7	5	7	5							2,581
Shoshone	135	97	9,892,910	7,110,529	1,974,458	163,880	150,580,100	6,263,204	62,017,841	2,728,785	16,361,388
Twin Falls	7	5	7	5							4,394
Valley	25	18	29,202	20,989	8,759	727	45,975	1,839			343,278
Washington	7	5	21,881	15,727	15,072	1,251	15,400	616			20,884
	12,185	8,758	10,240,953	7,360,685	2,095,867	173,957	158,040,250	6,321,610	62,105,568	2,732,645	19,522,704

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1935–36, by counties, in terms of recovered metals—Continued

County	Silver—Continued				Copper		Lead		Zinc		Total value
	Placer		Total								
	Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
1936—Continued											
Ada	53	$41	62	$48							$22,966
Adams			408	316	2,772	$255	522	$24			31,654
Benewah											560
Bingham											70
Blaine			318,195	246,442	108,783	10,008	5,568,044	256,130	9,570,380	$478,519	1,008,214
Boise	3,224	2,497	49,113	38,038	1,348	124	20,935	963			797,757
Bonner			141,605	109,673	7,554	695	1,244,087	57,228	4,700	235	169,448
Bonneville	9	7	9	7							4,963
Boundary			3,104	2,404	217	20	144,000	6,624			9,048
Butte			914	708			54,543	2,509			3,217
Camas	284	220	1,570	1,216	663	61	5,543	255	4,080	204	26,383
Canyon											28
Cassia			5	4							25
Clearwater	421	326	421	326							57,355
Custer	18	14	129,965	100,658	35,217	3,240	1,391,478	64,008			180,408
Elmore	40	31	27,450	21,260	4,489	413	196	9			173,897
Gem	13	10	199	154			717	33			6,599
Gooding											350
Idaho	4,794	3,713	28,816	22,318	1,413	130	7,196	331			1,036,365
Jerome	13	10	13	10							6,870
Latah	9	7	9	7							1,652
Lemhi	71	55	29,428	22,792	139,544	12,838	943,913	43,420			253,140
Nez Perce											1,015
Owyhee	2,009	1,556	9,100	7,048	54	5	1,087	50			146,375
Power	4	3	4	3							1,795
Shoshone	89	69	13,740,222	10,641,802	2,629,511	241,915	173,267,391	7,970,300	88,620,840	4,431,042	23,370,963
Twin Falls	9	7	9	7							3,640
Valley	93	72	34,195	26,484	2,022	186	11,609	534			318,957
Washington			22,714	17,592	20,413	1,878	16,739	770			20,758
	11,153	8,638	14,537,530	11,259,317	2,954,000	271,768	182,678,000	8,403,188	98,200,000	4,910,000	27,654,472

Gold and silver produced at placer mines in Idaho, 1935–36, by counties, in fine ounces, in terms of recovered metals

County	Sluicing		Dry-land dredges[1]		Floating (bucket) dredges		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1935								
Ada	145.34	18					145.34	18
Adams	.94						.94	
Benewah	26.20						26.20	
Bingham	2.20						2.20	
Blaine	1.86						1.86	
Boise	1,535.13	409			3,508.64	974	5,043.77	1,383
Bonneville	127.46	4					127.46	4
Boundary	.34						.34	
Camas	8.40				1,181.60	693	1,190.00	693
Canyon	2.66						2.66	
Clearwater	414.86	80			1,858.00	560	2,272.86	640
Custer	92.60	46					92.60	46
Elmore	194.43	36					194.43	36
Gem	15.03	7					15.03	7
Gooding	5.94						5.94	
Idaho	2,878.19	653			15,849.47	6,561	18,727.66	7,214
Jerome	110.74	7					110.74	7
Latah	86.77	11					86.77	11
Lemhi	625.57	85					625.57	85
Minidoka	7.06						7.06	
Nez Perce	29.26	4					29.26	4
Owyhee	722.75	1,100			1,219.25	756	1,942.00	1,856
Power	73.60	7					73.60	7
Shoshone	734.20	135					734.20	135
Twin Falls	125.40	7					125.40	7
Valley	89.74	25					89.74	25
Washington	77.40	7					77.40	7
	8,134.07	2,641			23,616.96	9,544	31,751.03	12,185
1936								
Ada	639.50	49	4.50	4			644.00	53
Benewah	16.00						16.00	
Bingham	2.00						2.00	
Blaine	1.20						1.20	
Boise	1,366.14	343			11,020.46	2,881	12,386.60	3,224
Bonneville	141.60	9					141.60	9
Camas					456.40	284	456.40	284
Canyon	.80						.80	
Clearwater	208.96	45	44.65	15	1,375.79	361	1,629.40	421
Custer	79.80	18					79.80	18
Elmore	244.40	40					244.40	40
Gem	68.80	13					68.80	13
Gooding	10.00						10.00	
Idaho	3,172.49	630			10,130.71	4,164	13,303.20	4,794
Jerome	196.00	13					196.00	13
Latah	47.00	9					47.00	9
Lemhi	697.60	71					697.60	71
Nez Perce	29.00						29.00	
Owyhee	527.77	38			3,114.83	1,971	3,642.60	2,009
Power	51.20	4					51.20	4
Shoshone	488.80	89					488.80	89
Twin Falls	103.80	9					103.80	9
Valley	189.60	93					189.60	93
	8,282.46	1,473	49.15	19	26,098.19	9,661	34,429.80	11,153

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

MINING INDUSTRY

The mining industry in Idaho improved to such an extent in 1936 that the value of the metal output rose from $19,522,704 in 1935 to $27,654,472 in 1936, an advance of nearly 42 percent. This large gain was due chiefly to the marked increases in the average sales prices of silver, lead, and zinc; silver from 71.875 cents an ounce in 1935 to 77.45 cents in 1936, lead from 4 to 4.6 cents a pound, and zinc from 4.4 to 5 cents a pound. As a result of increased metal prices mines in Idaho produced a record output of silver and zinc and the largest

output of lead since 1931. The output of gold decreased slightly due to the closing of the Boise-Rochester property at Atlanta, Elmore County, in June. However, the gradual yearly increase in the production of gold from bucket dredges is notable. The output of ore from mines in the Coeur d'Alene region, the chief producing area in Idaho, increased considerably, especially that of lead-zinc ore. The features of the year were the unusually large increase in production of silver from the Sunshine mine; the large increase in production of zinc from the Star, Bunker Hill, Sidney, and Morning mines; and the reopening of the Triumph lead-zinc mine near Ketchum, Blaine County. The smelter and refinery of the Bunker Hill & Sullivan Mining & Concentrating Co. were active throughout the year at an increased rate, and the electrolytic zinc plant of the Sullivan Mining Co. was worked at capacity. The Sullivan Mining Co. is planning to increase the capacity of the plant from 60 to 90 tons a day.

ORE CLASSIFICATION

Ore sold or treated in Idaho, 1935–36, with content in terms of recovered metals

Source	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1935							
Dry gold ore	180	262, 202	48, 204. 03	108, 208	46, 094	15, 336	----------
Dry gold and silver ore	25	382	1, 636. 91	54, 965	1, 798	13, 937	----------
Dry silver ore	15	181, 367	300. 25	6, 310, 726	1, 268, 009	602, 047	7, 863
	220	443, 951	50, 141. 19	6, 473, 899	1, 315, 901	631, 320	7, 863
Copper ore	9	243	24. 77	7, 189	33, 020	1, 937	----------
Lead ore	56	256, 077	574. 78	1, 400, 889	207, 189	46, 171, 658	748, 927
Lead-zinc ore	12	820, 674	1, 331. 29	2, 346, 791	539, 757	111, 235, 335	61, 348, 778
	77	1, 076, 994	1, 930. 84	3, 754, 869	779, 966	157, 408, 930	62, 097, 705
Total, lode mines	[1] 289	1, 520, 945	52, 072. 03	10, 228, 768	2, 095, 867	158, 040, 250	62, 105, 568
Total, placers	1, 079	----------	31, 751. 03	12, 185	----------	----------	----------
	1, 368	1, 520, 945	83, 823. 06	10, 240, 953	2, 095, 867	158, 040, 250	62, 105, 568
1936							
Dry gold ore	171	264, 446	42, 176. 01	97, 596	138, 182	64, 633	----------
Dry gold and silver ore	9	427	1, 174. 25	41, 603	1, 091	10, 026	----------
Dry silver ore	30	250, 265	412. 02	9, 991, 204	1, 924, 338	1, 249, 025	4, 700
	210	515, 138	43, 762. 28	10, 130, 403	2, 063, 611	1, 323, 684	4, 700
Copper ore	8	284	16. 81	1, 226	28, 465	174	----------
Lead ore	53	305, 967	545. 35	1, 601, 321	215, 399	51, 706, 702	1, 091, 460
Lead-zinc ore	19	986, 141	1, 537. 16	2, 793, 427	646, 525	129, 647, 440	97, 103, 840
	80	1, 292, 392	2, 099. 32	4, 395, 974	890, 389	181, 354, 316	98, 195, 300
Total, lode mines	[1] 281	1, 807, 530	45, 861. 60	14, 526, 377	2, 954, 000	182, 678, 000	98, 200, 000
Total, placers	828	----------	34, 429. 80	11, 153	----------	----------	----------
	1, 109	1, 807, 530	80, 291. 40	14, 537, 530	2, 954, 000	182, 678, 000	98, 200, 000

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

Value of metals from ore sold or treated in Idaho, 1935–36, by classes of ore

Class	Ore (short tons)	Gold	Silver	Copper	Lead	Zinc	Total value
1935							
Dry gold ore	262, 202	$1, 687, 141	$77, 775	$3, 826	$613		$1, 769, 355
Dry gold and silver ore	382	57, 292	39, 506	149	558		97, 505
Dry silver ore	181, 367	10, 509	4, 535, 834	105, 245	24, 082	$346	4, 676, 016
	443, 951	1, 754, 942	4, 653, 115	109, 220	25, 253	346	6, 542, 876
Copper ore	243	867	5, 167	2, 740	78		8, 852
Lead ore	256, 077	20, 117	1, 006, 889	17, 197	1, 846, 866	32, 953	2, 924, 022
Lead-zinc ore	820, 674	46, 595	1, 686, 756	44, 800	4, 449, 413	2, 699, 346	8, 926, 910
	1, 076, 994	67, 579	2, 698, 812	64, 737	6, 296, 357	2, 732, 299	11, 859, 784
Total, lode mines	1, 520, 945	1, 822, 521	7, 351, 927	173, 957	6, 321, 610	2, 732, 645	18, 402, 660
Total, placers		1, 111, 286	8, 758				1, 120, 044
	1, 520, 945	2, 933, 807	7, 360, 685	173, 957	6, 321, 610	2, 732, 645	19, 522, 704
1936							
Dry gold ore	264, 446	1, 476, 160	75, 588	12, 713	2, 973		1, 567, 434
Dry gold and silver ore	427	41, 099	32, 221	100	461		73, 881
Dry silver ore	250, 265	14, 421	7, 738, 188	177, 039	57, 455	235	7, 987, 338
	515, 138	1, 531, 680	7, 845, 997	189, 852	60, 889	235	9, 628, 653
Copper ore	284	588	950	2, 619	8		4, 165
Lead ore	305, 967	19, 087	1, 240, 223	19, 817	2, 378, 509	54, 573	3, 712, 209
Lead-zinc ore	986, 141	53, 801	2, 163, 509	59, 480	5, 963, 782	4, 855, 192	13, 095, 764
	1, 292, 392	73, 476	3, 404, 682	81, 916	8, 342, 299	4, 909, 765	16, 812, 138
Total, lode mines	1, 807, 530	1, 605, 156	11, 250, 679	271, 768	8, 403, 188	4, 910, 000	26, 440, 791
Total, placers		1, 205, 043	8, 638				1, 213, 681
	1, 807, 530	2, 810, 199	11, 259, 317	271, 768	8, 403, 188	4, 910, 000	27, 654, 472

Gold ore.—The output of gold ore in Idaho was 264,446 tons (including old tailings) from 171 properties in 1936 compared with 262,202 tons from 180 properties in 1935; it represented nearly 15 percent of the total output of ore in the State in 1936. More than 76 percent of the total gold ore (and old tailings) was produced from the Orogrande-Frisco property near Orogrande, Yellow Pine property at Stibnite, Gold Hill mine at Quartzburg, and Boise-Rochester mine at Atlanta.

Gold and silver ore.—The output of 427 tons of gold and silver ore in Idaho in 1936 came chiefly from the Come-Back mine in Boise County and the Wilson mine in Owyhee County.

Silver ore.—Thirty mines produced 250,265 tons of silver ore in 1936 compared with 15 mines producing 181,367 tons in 1935. More than 97 percent of the total came from the Sunshine and Crescent mines in Shoshone County and the Hewer property in Bonner County.

Copper ore.—A little copper ore (284 tons) was produced from eight mines in Idaho in 1936; the output in 1935 was 243 tons.

Lead ore.—The output of lead ore was 305,967 tons from 53 properties in 1936 compared with 256,077 tons from 56 properties in 1935. Nearly 98 percent of the total came from the Hecla and Gold Hunter mines in the Coeur d'Alene region, the Clayton mine in the Bay Horse district, and the Hope property in the Pend d'Oreille district.

Lead-zinc ore.—The output of lead-zinc ore (including old tailings) was 986,141 tons from 19 properties in 1936 compared with 820,674 tons from 12 properties in 1935. Except for a small lot of ore from Camas County, all lead-zinc ore (and old tailings) produced in 1936

came from 13 mines in Shoshone County and 5 mines in Blaine County and was treated by flotation. It represented more than 54 percent of the total ore. The Bunker Hill property continued to be the leading producer of lead-zinc ore, followed by the Morning, Star, Page, Frisco, Triumph, and Sidney.

Ore sold or treated in Idaho, 1935–36, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ada	426	23.97	14			
Adams	877	1,290.76	564	150	525	
Blaine	243	180.70	612	951	481	
Boise	35,909	6,372.88	2,636	405	2,952	
Boundary	5	2.80	14		75	
Camas	1,474	322.06	192	158	878	
Clearwater	5	3.60				
Custer	1,571	180.12	1,348			
Elmore	81,412	19,812.60	63,630	7,072		
Gem	35	45.80	139		850	
Idaho	71,013	8,253.60	10,695	1,072	6,350	
Lemhi	14,910	2,563.54	2,016	25,672	1,150	
Owyhee	239	129.02	384			
Shoshone	334	82.60	139	1,988	1,925	
Valley	53,725	8,929.38	25,814	8,530	150	
Washington	24	10.60	11	96		
	262,202	48,204.03	108,208	46,094	15,336	
1936						
Ada	41	10.80	9			
Adams	887	886.75	377	210	522	
Blaine	233	168.43	757	443	3,650	
Boise	43,613	8,234.59	6,822	215	10,396	
Camas	809	247.13	324	573	4,025	
Cassia	2	.60	5			
Custer	111	174.13	630		1,638	
Elmore	29,893	4,060.78	26,151	1,902	22	
Gem	121	114.40	186		717	
Idaho	121,053	15,656.40	24,022	1,413	7,196	
Lemhi	22,260	4,185.01	4,430	127,393	20,781	
Owyhee	832	242.63	442		755	
Shoshone	511	91.80	293	3,946	14,109	
Valley	44,068	8,091.16	33,117	2,022	822	
Washington	12	11.40	31	65		
	264,446	42,176.01	97,596	138,182	64,633	

DRY GOLD AND SILVER ORE

1935						
Boise	240	1,557.01	51,180	1,750	13,712	
Custer	9	9.77	375			
Lemhi	19	1.30	84	48	225	
Owyhee	102	64.41	3,028			
Valley	12	4.42	298			
	382	1,636.91	54,965	1,798	13,937	
1936						
Boise	182	1,048.01	38,000	1,091	9,794	
Custer	6	5.98	297		145	
Elmore	20	43.42	829			
Owyhee	217	72.00	2,276			
Valley	2	4.84	201		87	
	427	1,174.25	41,603	1,091	10,026	

Ore sold or treated in Idaho, 1935–36, by counties, with content in terms of recovered metals—Continued

DRY SILVER ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Blaine	429	47.13	4,414	84	3,200	----------
Boise	13	2.71	901	496	936	----------
Bonner	4,563	16.60	43,390	2,746	54,107	7,863
Butte	53	.40	1,365	530	1,700	----------
Custer	283	4.76	16,222	12,380	13,218	----------
Elmore	1	1.60	1,390	----------	----------	----------
Owyhee	31	3.97	3,109	----------	450	----------
Shoshone	175,058	217.08	6,218,072	1,236,797	513,036	----------
Washington	936	6.00	21,863	14,976	15,400	----------
	181,367	300.25	6,310,726	1,268,009	602,047	7,863
1936						
Blaine	13	.80	417	22	109	----------
Boise	28	6.00	1,067	42	745	----------
Bonner	9,114	43.40	104,443	7,554	122,602	4,700
Custer	484	42.09	9,295	663	413	----------
Lemhi	600	2.00	3,694	5,457	11,522	----------
Owyhee	124	21.97	4,373	54	332	----------
Shoshone	239,092	292.36	9,845,232	1,890,198	1,096,563	----------
Washington	810	3.40	22,683	20,348	16,739	----------
	250,265	412.02	9,991,204	1,924,338	1,249,025	4,700

COPPER ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
1935						
Adams	6	0.30	193	609	----------	----------
Custer	195	15.85	3,365	27,197	472	----------
Lemhi	41	6.62	3,617	5,142	1,465	----------
Nez Perce	1	2.00	14	72	----------	----------
	243	24.77	7,189	33,020	1,937	----------
1936						
Adams	9	.65	31	2,562	----------	----------
Custer	189	9.03	741	21,547	----------	----------
Elmore	52	.40	430	2,587	174	----------
Lemhi	34	6.73	24	1,769	----------	----------
	284	16.81	1,226	28,465	174	----------

LEAD ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
1935						
Blaine	128	12.70	4,928	901	51,810	----------
Bonner	4,764	.80	12,713	170	376,968	----------
Boundary	18	----------	395	24	16,050	----------
Butte	23	.20	139	----------	4,150	----------
Camas	77	2.14	4,320	203	8,547	----------
Custer	9,064	19.30	38,345	6,833	531,235	----------
Lemhi	506	77.14	7,094	2,271	274,285	----------
Shoshone	241,379	351.10	1,329,890	196,558	44,862,788	748,927
Valley	118	111.40	3,065	229	45,825	----------
	256,077	574.78	1,400,889	207,189	46,171,658	748,927
1936						
Blaine	986	24.28	11,764	479	200,203	----------
Bonner	10,250	2.80	37,162	----------	1,121,485	----------
Boundary	153	----------	3,104	217	144,000	----------
Butte	81	----------	914	----------	54,543	----------
Custer	25,363	46.17	118,984	13,007	1,389,282	----------
Lemhi	1,399	82.66	21,209	4,925	911,610	----------
Shoshone	267,696	339.24	1,407,400	196,771	47,874,879	1,091,460
Valley	39	50.20	784	----------	10,700	----------
	305,967	545.35	1,601,321	215,399	51,706,702	1,091,460

Ore sold or treated in Idaho, 1935–36, by counties, with content in terms of recovered metals—Continued

LEAD-ZINC ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Blaine	201	2.27	2,117	642	32,984	79,864
Shoshone	820,473	1,329.02	2,344,674	539,115	111,202,351	61,268,914
	820,674	1,331.29	2,346,791	539,757	111,235,335	61,348,778
1936						
Blaine	38,431	294.29	305,257	107,839	5,364,082	9,570,380
Camas	22	.67	962	90	1,518	4,080
Shoshone	947,688	1,242.20	2,487,208	538,596	124,281,840	87,529,380
	986,141	1,537.16	2,793,427	646,525	129,647,440	97,103,840

Zinc products (as marketed from Idaho mines and mills) sold to smelters and electrolytic plants, 1935–36

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of concentrates, etc.	Recovered zinc
1935		*Short tons*	*Pounds*	*Percent*	*Pounds*
Zinc concentrates	Blaine, Bonner, and Shoshone.	66,474	69,062,704	51.95	62,092,441
Lead-zinc old mill cleanings.	Shoshone	20	14,502	36.26	13,127
		66,494	69,077,206	51.94	62,105,568
1936					
Zinc concentrates	Blaine, Bonner, Camas, and Shoshone.	104,442	108,640,853	52.01	98,200,000

METALLURGIC INDUSTRY

The 1,807,530 tons of ore (including old tailings) produced in 1936 in Idaho comprised 196,011 tons (10.85 percent) treated at gold and silver mills, 1,583,287 tons (87.59 percent) treated at concentration plants, and 28,232 tons (1.56 percent) shipped crude to smelters.

Of the ore (and old tailings) treated at gold and silver mills, 50,713 tons were treated at straight amalgamation plants, 46,657 tons were treated by combined amalgamation and concentration, and 98,641 tons (including 2,700 tons of old tailings) were treated at straight cyanidation plants. In 1935, 41,017 tons of ore (and old tailings) were treated by amalgamation, 91,480 tons by combined amalgamation and concentration, and 51,504 tons by cyanidation. Nearly 82 percent of the ore treated by amalgamation in 1936 came from mines in the Boise Basin district; 96 percent of the ore treated by amalgamation and concentration came from mines in the Middle Boise, Marshall Lake, McDevitt, and Warren districts; and 96 percent of the ore and old tailings treated by cyanidation came from mines in the Orogrande district.

Ore and old tailings treated at straight concentration plants increased from 1,315,585 tons in 1935 to 1,583,287 tons in 1936. Siliceous material treated at concentration plants increased from 255,021 to 309,547 tons; lead ore from 239,896 to 287,571 tons; and lead-zinc ore and old tailings from 820,654 to 986,141 tons. A little copper ore was also treated by concentration.

Mine production of metals from gold and silver mills in Idaho, 1935–36, by counties, in terms of recovered metals

County	Ore, old tailings, etc., treated (dry weight)		Recovered in bullion				Concentrates and recovered metal				
			Amalgamation		Cyanidation						
	Ore	Old tailings, etc.	Gold	Silver	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
1935											
Ada	425		17.43	12			1	2.50			
Boise	34,648		6,084.74	1,037			123	128.53	927	90	419
Camas	14		45.54	16							
Clearwater	5		3.60								
Custer		560			69.92	400					
Elmore	57,657	20,450	10,556.34	11,977			1,492	9,097.01	50,837	7,072	
Gem	13		36.00	20							
Idaho	62,102	2,535	4,150.92	1,803	2,294.11	1,097	68	1,128.48	5,907	253	3,600
Lemhi	2,587		244.81	43	3.70		71	112.72	251	23,552	
Owyhee	158	75	96.11	127			4	5.72	261		
Shoshone	12		9.60	3							
Valley	2,760		441.75	252			20	114.25	345	3,530	150
	160,381	23,620	21,686.84	15,290	2,367.73	1,497	1,779	10,589.21	58,528	34,497	4,169
1936											
Adams	566				463.00	110					
Boise	42,157		7,647.99	1,630			28	23.24	316	100	181
Camas	100		86.00	29							
Cassia	2				.60	5					
Custer	50		95.00	77							
Elmore	29,680		2,233.66	2,036			256	1,300.25	18,320	1,902	
Gem	104		102.90	49							
Idaho	115,221	2,700	8,186.77	4,042	4,933.12	2,324	60	1,921.18	16,411	934	3,761
Lemhi	4,405		246.86	30			133	203.20	1,223	116,550	
Owyhee	226		107.08	178			1	2.00	21		
Shoshone	100		35.80	18							
Valley	700		153.00	111							
	193,311	2,700	18,895.06	8,200	5,396.72	2,439	478	3,449.87	36,291	119,486	3,942

Mine production of metals from concentrating mills in Idaho, 1935–36, by counties, in terms of recovered metals

County	Ore and old tailings treated		Concentrates and recovered metal					
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Blaine	576		157	47.64	5,786	726	34,984	79,864
Boise	1,230		48	60.70	439	235	2,295	
Bonner	9,249		402	14.60	47,966	2,050	420,240	7,863
Camas	1,460		25	276.52	176	158	878	
Custer	8,891	1,000	477	76.44	33,850	6,652	426,874	
Elmore	1,800	1,500	20	155.64	815			
Idaho	6,251		38	461.97	1,531	795	2,525	
Lemhi	11,663		336	1,519.88	1,259	1,758	600	
Owyhee	12		1	.20	163			
Shoshone	1,205,820	15,168	194,900	1,839.34	9,365,493	1,887,703	144,821,044	62,004,714
Valley	50,965		3,602	8,373.38	25,217	5,000		
	1,297,917	17,668	200,006	12,826.31	9,482,695	1,905,077	145,709,440	62,092,441
1936								
Ada	40		3	7.80	9			
Blaine	38,431		19,389	294.29	305,257	107,839	5,364,082	9,570,380
Boise	1,300		196	275.50	4,590	115	10,215	
Bonner	19,250		1,110	40.82	121,113	5,174	1,242,060	4,700
Butte	48		24		527		24,254	
Camas	727		42	155.65	1,228	613	5,163	4,080
Custer	24,980		1,069	44.47	88,183	4,120	1,188,245	
Idaho	3,057		35	503.25	1,032	349	3,313	
Lemhi	18,057		854	3,191.12	6,505	16,771	32,253	
Owyhee	855		40	160.47	2,711	28	695	
Shoshone	1,422,218	11,000	235,461	1,827.71	13,104,952	2,511,438	161,202,884	88,620,840
Valley	43,324		3,787	7,797.96	32,615	1,924		
	1,572,287	11,000	262,010	14,299.04	13,668,722	2,648,371	169,073,164	98,200,000

Gross metal content of Idaho concentrates produced, 1935–36, by classes of concentrates

Class of concentrates	Concentrates produced (dry weight)	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	5,853	21,446.56	92,241	20,968	18,058	
Copper	6,735	348.87	5,876,081	1,507,768	309,719	
Lead	121,904	1,000.70	3,123,524	648,140	148,274,284	
Zinc	66,474	609.47	229,571	211,620	3,561,128	69,062,704
Copper-lead	819	9.92	219,806	75,250	221,297	
	201,785	23,415.52	9,541,223	2,463,746	152,684,486	69,062,704
1936						
Dry and siliceous	10,751	15,180.29	97,008	22,508	166,393	
Copper	9,120	483.27	9,104,345	2,249,031	878,578	
Lead	137,080	1,193.47	3,644,986	636,503	168,493,840	12,395,694
Zinc	104,442	831.30	357,051	366,833	6,533,974	108,640,853
Copper-lead	1,095	60.58	501,623	158,916	198,224	
	262,488	17,748.91	13,705,013	3,433,791	176,271,009	121,036,547

Mine production of metals from Idaho concentrates, 1935–36, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ada	1	2.50	----------	----------	----------	----------
Blaine	157	47.64	5,786	726	34,984	79,864
Boise	171	189.23	1,366	325	2,714	----------
Bonner	402	14.60	47,966	2,050	420,240	7,863
Camas	25	276.52	176	158	878	----------
Custer	477	76.44	33,850	6,652	426,874	----------
Elmore	1,512	9,252.65	51,652	7,072	----------	----------
Idaho	106	1,590.45	7,438	1,048	6,125	----------
Lemhi	407	1,632.60	1,510	25,310	600	----------
Owyhee	5	5.92	424	----------	----------	----------
Shoshone	194,900	1,839.34	9,365,493	1,887,703	144,821,044	62,004,714
Valley	3,622	8,487.63	25,562	8,530	150	----------
	201,785	23,415.52	9,541,223	1,939,574	145,713,609	62,092,441
1936						
Ada	3	7.80	9	----------	----------	----------
Blaine	19,389	294.29	305,257	107,839	5,364,082	9,570,380
Boise	224	298.74	4,906	215	10,396	----------
Bonner	1,110	40.82	121,113	5,174	1,242,060	4,700
Butte	24	----------	527	----------	24,254	----------
Camas	42	155.65	1,228	613	5,163	4,080
Custer	1,069	44.47	88,183	4,120	1,188,245	----------
Elmore	256	1,300.25	18,320	1,902	----------	----------
Idaho	95	2,424.43	17,443	1,283	7,074	----------
Lemhi	987	3,394.32	7,728	133,321	32,253	----------
Owyhee	41	162.47	2,732	28	695	----------
Shoshone	235,461	1,827.71	13,104,952	2,511,438	161,202,884	88,620,840
Valley	3,787	7,797.96	32,615	1,924	----------	----------
	262,488	17,748.91	13,705,013	2,767,857	169,077,106	98,200,000

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
1935						
Dry and siliceous	5,853	21,446.56	92,241	16,667	14,822	----------
Copper	6,735	348.87	5,876,081	1,180,493	295,367	----------
Lead	121,904	1,000.70	3,123,524	500,592	141,599,971	----------
Zinc	66,474	609.47	229,571	183,127	3,592,110	62,092,441
Copper-lead	819	9.92	219,806	58,695	211,339	----------
	201,785	23,415.52	9,541,223	1,939,574	145,713,609	62,092,441
1936						
Dry and siliceous	10,751	15,180.29	97,008	18,611	135,081	----------
Copper	9,120	483.27	9,104,345	1,817,727	843,434	----------
Lead	137,080	1,193.47	3,644,986	500,867	161,739,089	----------
Zinc	104,442	831.30	357,051	296,395	6,169,490	98,200,000
Copper-lead	1,095	60.58	501,623	134,257	190,012	----------
	262,488	17,748.91	13,705,013	2,767,857	169,077,106	98,200,000

Gross metal content of Idaho crude ore shipped to smelters, 1935–36, by classes of ore

Class of ore	Quantity (dry weight)	Gross metal content			
		Gold	Silver	Copper	Lead
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry and siliceous	4,876	4,159.29	233,036	75,873	69,340
Copper	220	21.27	6,689	33,378	1,085
Lead	16,064	308.62	427,272	85,922	12,750,262
	21,160	4,489.18	666,997	195,173	12,820,687
1936					
Gold	1,580	2,343.15	8,895	2,322	11,950
Gold and silver	252	1,138.25	40,132	1,820	10,542
Silver	7,748	75.73	300,546	114,786	113,985
Copper	256	11.74	1,217	28,320	274
Lead	18,396	252.04	459,943	90,264	14,039,773
	28,232	3,820.91	810,733	237,512	14,176,524

Mine production of metals from Idaho crude ore shipped to smelters, 1935–36, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Adams	883	1,291.06	757	759	525
Blaine	406	195.05	5,412	1,852	45,060
Boise	280	1,619.60	52,162	2,326	14,886
Bonner	78	2.80	8,137	866	10,835
Boundary	23	2.80	409	24	16,125
Butte	76	.60	1,504	530	5,850
Camas	77	2.14	4,320	203	8,547
Custer	669	69.56	25,367	39,758	118,051
Elmore	6	5.21	1,391		
Gem	22	9.80	119		850
Idaho	125	218.12	357	24	225
Lemhi	1,177	742.48	10,709	6,827	275,625
Nez Perce	1	2.00	14	72	
Owyhee	122	68.58	5,504		450
Shoshone	16,125	127.01	525,598	86,617	11,664,136
Valley	130	115.82	3,363	229	45,825
Washington	960	16.60	21,874	15,072	15,400
	21,160	4,489.18	666,997	155,159	12,222,390
1936					
Ada	1	3.00			
Adams	330	424.40	298	2,772	522
Blaine	1,232	193.51	12,938	944	203,962
Boise	366	1,341.87	39,353	1,133	10,539
Bonner	114	5.38	20,492	2,380	2,027
Boundary	153		3,104	217	144,000
Butte	33		387		30,289
Camas	4	6.15	29	50	380
Custer	1,123	137.93	41,687	31,097	203,233
Elmore	285	570.69	7,054	2,587	196
Gem	17	11.50	137		717
Idaho	75	112.08	213	130	122
Lemhi	1,831	635.22	21,599	6,223	911,660
Owyhee	92	67.05	4,181	26	392
Shoshone	21,669	102.09	635,171	118,073	12,064,507
Valley	85	195.24	1,376	98	11,609
Washington	822	14.80	22,714	20,413	16,739
	28,232	3,820.91	810,733	186,143	13,600,894

Mine production of metals from Idaho crude ore shipped to smelters, 1935–36, in terms of recovered metals—Continued

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry and siliceous	4,876	4,159.29	233,036	58,763	56,947
Copper	220	21.27	6,689	31,455	1,037
Lead	16,064	308.62	427,272	64,941	12,164,406
	21,160	4,489.18	666,997	155,159	12,222,390
1936					
Gold	1,580	2,343.15	8,895	1,848	8,602
Gold and silver	252	1,138.25	40,132	1,091	10,026
Silver	7,748	75.73	300,546	88,559	108,434
Copper	256	11.74	1,217	27,288	174
Lead	18,396	252.04	459,943	67,357	13,473,658
	28,232	3,820.91	810,733	186,143	13,600,894

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1935–36, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
1935			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Ada County:													
Black Hornet	3		426	23.97		23.97	14		14				$849
Boise		5			10.03	10.03							351
Boise River		8			8.74	8.74							306
Highland		4			55.97	55.97		11	11				1,967
Snake River		5			70.60	70.60		7	7				2,476
Adams County:													
Goose Creek		1			.94	.94							33
Seven Devils	2		883	1,291.06		1,291.06	757		757	759	525		45,815
Benewah County: Tyson Creek		6			26.20	26.20							917
Bingham County: Snake River		1			2.20	2.20							77
Blaine County:													
Mineral Hill	20		344	191.17		191.17	2,393		2,393	1,000	22,200	1,750	9,459
Sawtooth	1		3	.26		.26	100		100				81
Vienna	1		375	45.37		45.37	3,669		3,669	84	2,000		4,312
Warm Springs	6	1	279	6.00	1.86	7.86	5,909		5,909	1,494	64,275	78,114	10,654
Boise County:													
Banner	1	5	8	1.80	6.26	8.06							282
Bogus Basin		1			.77	.77							27
Boise Basin	24	127	35,986	7,847.40	4,981.54	12,828.94	54,610	1,369	55,979	2,651	17,600		490,172
Dry Buck Creek		1			.46	.46							16
Garden Valley		7			26.74	26.74		7	7				941
Highland		1			.54	.54							19
Miller Creek		1			2.00	2.00							70
Payette River		3			2.23	2.23							78
Shaw Mountain	3		63	12.80		12.80	4		4				451
South Fork of Payette River		6			23.23	23.23		7	7				818
Summit Flat	4		97	68.60		68.60	32		32				2,424
West View	1		8	2.00		2.00	71		71				121
Bonner County: Lakeview and Pend d'Oreille	6		9,327	17.40		17.40	56,103		56,103	2,916	431,075	7,863	58,764
Bonneville County: Mount Pisgah		5			127.46	127.46		4	4				4,464
Boundary County:													
Moyie Yahk	2	1	5	2.80	.34	3.14	14		14		75		123
Port Hill	1		18				395		395	24	16,050		928

Butte County:													
Antelope Creek	1		40	.40		.40	519		519	12	1,700		456
Dome	1		(1)						(1)	(1)			(1)
Lava Creek	1		23	.20		.20	139		139		4,150		273
Camas County:													
Little Smoky	2	4	237	11.40	1,188.14	1,199.54	4,352	693	5,045	313	8,875		45,991
Skeleton Creek	3		1,314	312.80		312.80	160		160	48	550		11,089
South Fork of Boise River		1			1.86	1.86							65
Canyon County:													
Boise River		1			2.26	2.26							79
Snake River		1			.40	.40							14
Clearwater County:													
Clearwater River		2			5.40	5.40							189
Elk River		4			139.63	139.63		32	32				4,910
Moose Creek		10			83.63	83.63		11	11				2,935
North Fork of Clearwater River		13			40.80	40.80		7	7				1,433
Pierce	1	51	5	3.60	2,003.40	2,007.00		590	590				70,669
Custer County:													
Alder Creek	2		259	11.80		11.80	2,158		2,158	26,518	24,350		5,139
Alto	1		4				43		43		275		42
Bay Horse	6	1	9,183	14.60	7.54	22.14	49,401	7	49,408	19,121	450,050		55,876
Boulder	1		86	5.60		5.60	3,911		3,911		69,075		5,770
East Fork	1		2	.20		.20	53		53		625		70
Greyhound		1			25.34	25.34		7	7				892
Loon Creek		1			7.86	7.86							275
Salmon River		4			1.66	1.66							58
Seafoam	1		1	.20		.20	11		11				15
Stanley Basin	1	5	3	12.40	42.06	54.46	14	18	32				1,929
Yankee Fork	10	3	1,584	185.00	8.14	193.14	4,064	14	4,078	771	550		9,777
Elmore County:													
Bear Creek	4	1	1,852	128.40	5.66	134.06	57		57				4,733
Black Warrior	3	1	6	2.60	1.06	3.66							128
Boise River		18			78.74	78.74		21	21				2,771
Dixie	1		(1)	(1)		(1)	(1)		(1)				(1)
Middle Boise	4	15	79,552	19,678.60	61.86	19,740.46	63,573	11	63,584	7,072			737,204
Neal	1	1	1	1.00	6.54	7.54		4	4				267
Pine Grove	1	1	1	2.00	1.00	3.00							105
Snake River		4			33.40	33.40							1,160
Yuba River		1			6.17	6.17							216
Gem County: West View	4	8	35	45.80	15.03	60.83	139	7	146		850		2,268
Gooding County: Snake River		7			5.94	5.94							208
Idaho County:													
Blacktail		4			29.37	29.37		7	7				1,033
Camp Howard		106			611.00	611.00		135	135				21,482
Clearwater River		3			6.17	6.17							216
Deep Creek		1			5.83	5.83							204
Dixie	8	11	2,728	96.80	337.86	434.66	89	71	160		150		15,334
Elk City	6	23	146	44.60	820.86	865.46	64	153	217	48	225		30,460
Florence	8	13	186	52.40	74.14	126.54	25	32	57				4,470
Lower Salmon River		14			169.23	169.23		32	32				5,946

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1935–36, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
1935—Continued													
Idaho County—Continued.			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Maggie and Pete King Creeks		4			9.46	9.46		7	7				$336
Marshall Lake	5	10	2,905	1,699.40	14.00	1,713.40	5,927	7	5,934	48	225		64,247
Middle Fork of Clearwater River		1			1.80	1.80							63
Newsome	1	4	500	53.40	20.20	73.60	18	7	25				2,594
Orogrande	5	3	51,700	3,211.40	11.14	3,222.54	1,440		1,440	205	3,375		113,976
Proctor Creek		2			24.57	24.57		7	7				865
Robbins	4		5,932	580.60		580.60	1,941		1,941	747	2,300		21,870
Salmon River		27			82.43	82.43		18	18				2,898
Simpson	1	150	(1)	(1)	348.00	[2] 348.00	(1)	75	[2] 75				[2] 12,234
Snake River		4			13.46	13.46							471
South Fork of Salmon River		3			5.14	5.14							180
Ten Mile	6	10	6,356	2,324.20	81.54	2,405.74	1,088	14	1,102	24	75		84,998
Warren	2	11	176	90.80	16,052.26	16,143.06	57	6,649	6,706				569,827
White Mike Creek		2			9.20	9.20							322
Jerome County: Snake River		20			110.74	110.74		7	7				3,881
Latah County:													
Gold Creek		3			10.80	10.80							378
Hoodoo		9			54.23	54.23		7	7				1,903
Moscow Mountain		4			21.74	21.74		4	4				764
Lemhi County:													
Blackbird	1		283	339.40		339.40	160		160				11,994
Blue Wing	1		9	.40		.40	491		491	771	900		467
Boyle Creek	1		1	2.40		2.40	64		64	72	225		145
Eldorado	1		2	6.00		6.00							210
Eureka	6	18	83	48.20	198.83	247.03	96	25	121	121	225		8,752
Gibbonsville	13	4	212	170.20	14.46	184.66	160		160	795			6,644
Indian Creek	2		842	238.20		238.20	32		32				8,360
Junction	2		19	.20		.20	3,278		3,278	1,542	8,450		2,829
Kirtley Creek		5			8.54	8.54							299
McDevitt	1		1,506	100.40		100.40	267		267	24,988			5,780
Mackinaw	2	22	328	96.40	213.94	310.34	1,536	14	1,550	747	25,700		13,066
Middle Fork of Salmon River		1			2.94	2.94							103
Mineral Hill	7		11,730	1,570.00		1,570.00	1,273		1,273	964	600		55,969
Parker Mountain	2		8	22.80		22.80	78		78				854
Pratt Creek	2		12	6.20		6.20	18		18	96	550		260
Ramsack Creek		1			8.06	8.06							282
Salmon River		31			156.06	156.06		39	39				5,490

Spring Mountain	2		6	.80		.80	7		7	506			75
Texas	2		372	14.80		14.80	5,326		5,326	1,410	240,475		14,082
Yellow Jacket	4	3	63	32.20	22.74	54.94	25	7	32	1,121			2,039
Minidoka County: Snake River		3			7.06	7.06							247
Nez Perce County:													
Clearwater River		6			11.43	11.43							400
Deer Creek	1		1	2.00		2.00	14		14	72			86
Snake River		10			17.83	17.83		4	4				627
Owyhee County:													
Carson	25	7	260	149.80	1,288.63	1,438.43	2,990	1,817	4,807				53,800
Castle Creek	4		48	33.00		33.00	2,891		2,891		450		3,251
Snake River		24			642.74	642.74		32	32				22,519
Steele	3	2	64	14.60	10.63	25.23	640	7	647				1,348
Power County: Snake River		11			73.60	73.60		7	7				2,581
Shoshone County:													
Beaver	1	9	21	25.00	46.86	71.86	39	7	46				2,548
Coeur d'Alene	2	8	13	12.80	203.63	216.43	4	32	36				7,601
Eagle		1			3.83	3.83							134
Evolution	1		160,451	201.00		201.00	5,876,910		5,876,910	1,152,711	319,475		4,339,518
Hunter	4		364,121	360.20		360.20	1,126,862		1,126,862	202,470	52,853,150	32,474,205	4,382,335
Lelande	8		267,897	381.20		381.20	1,189,362		1,189,362	204,494	43,973,525	4,992,091	2,863,762
Placer Center	3		628	3.00		3.00	10,464		10,464	952	372,225	18,227	23,396
St. Joe		3			44.20	44.20							1,547
Summit	1	54	300	44.80	434.94	479.74	96	96	192	1,988	1,925		17,171
Yreka	8	1	443,813	951.80	.74	952.54	1,689,038		1,689,038	411,843	59,059,800	24,533,318	4,723,376
Twin Falls County: Snake River		37			125.40	125.40		7	7				4,394
Valley County:													
Big Creek	1	6	250	128.60	13.46	142.06	334	4	338	3,530	150		5,514
Brush Creek		1			1.54	1.54							54
Deadwood	1	1	(1)	(1)	1.94	[2] 1.94	(1)		(1)				[2] 68
Hurdy Creek		1			2.77	2.77							97
Lake City		4			36.40	36.40		7	7				1,279
Middle Fork of Salmon River		4			5.86	5.86							205
Payette River		2			5.94	5.94							208
Pistol Creek	1		(1)	(1)		(1)	(1)		(1)	(1)	(1)		(1)
Secesh		1			.86	.86							30
South Fork of Salmon River		1			6.63	6.63							232
Thunder Mountain	1	3	2,340	393.40	14.34	407.74	249	14	263				14,460
Yellow Pine	2		50,977	8,377.80		8,377.80	25,515		25,515	5,000			311,977
Washington County:													
Heath	1		24	10.60		10.60	11		11	96			387
Snake River		4			77.40	77.40		7	7				2,714
Washington	1		936	6.00		6.00	21,863		21,863	14,976	15,400		17,783
Undistributed [3]			686	247.00		247.00	5,361		5,361	747	45,825		14,393
Total Idaho	289	1,079	1,520,945	52,072.03	31,751.03	83,823.06	10,228,768	12,185	10,240,953	2,095,867	158,040,250	62,105,568	19,522,704

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1935–36, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
1936			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Ada County:													
Black Hornet	2		41	10.80		10.80	9		9				$385
Boise		7			5.60	5.60							196
Highland		4			43.20	43.20		13	13				1,522
Snake River		6			595.20	595.20		40	40				20,863
Adams County: Seven Devils	5		896	887.40		887.40	408		408	2,772	522		31,654
Benewah County: Tyson Creek		4			16.00	16.00							560
Bingham County: Snake River		1			2.00	2.00							70
Blaine County:													
Little Wood River	1		(1)	(1)		(1)	(1)		(1)	(1)	(1)	(1)	(1)
Mineral Hill	17		320	175.00		175.00	1,774		1,774	598	25,478	9,000	9,176
Sawtooth	1		(1)	(1)		(1)	(1)		(1)	(1)	(1)		(1)
Snake River		1			1.20	1.20							42
Warm Springs	8		39,188	303.40		303.40	314,536		314,536	107,696	5,513,283	9,541,440	994,818
Boise County:													
Banner		2			.60	.60							21
Boise Basin	25	112	43,309	8,814.80	12,335.80	21,150.60	45,530	3,215	48,745	1,348	20,935		779,111
Eight Mile Creek	1		(1)	(1)		(1)	(1)		(1)				(1)
Garden Valley		8			31.80	31.80		9	9				1,120
Grimes Pass	1		(1)	(1)		(1)	(1)		(1)				(1)
Highland		5			2.00	2.00							70
Payette River		1			2.20	2.20							77
Shaw Mountain	2		132	44.40		44.40	18		18				1,568
South Fork of Payette River		9			14.20	14.20							497
Summit Flat	3		245	381.00		381.00	217		217				13,503
Bonner County:													
Lakeview	2		9,004	38.20		38.20	84,678		84,678	5,174	120,609	4,700	73,179
Pend d'Oreille	6		10,360	8.00		8.00	56,927		56,927	2,380	1,123,478		96,269
Bonneville County: Mt. Pisgah		5			141.60	141.60		9	9				4,963
Boundary County: Port Hill	1		(1)				(1)		(1)	(1)	(1)		(1)
Butte County:													
Dome	1		(1)				(1)		(1)		(1)		(1)
Hamilton	1		(1)				(1)		(1)		(1)		(1)
Camas County:													
Little Smoky	3	1	281	52.00	456.40	508.40	1,180	284	1,464	630	5,130	4,080	19,426
Skeleton Creek	2		550	195.80		195.80	106		106	33	413		6,957
Canyon County: Boise River		1			.80	.80							28
Cassia County: Black Pine	1		(1)	(1)		(1)	(1)		(1)				(1)

Clearwater County:													
Burnt Creek		2			4.00	4.00							140
Clearwater River		8			10.80	10.80							378
Elk River		1			.40	.40							14
Moose Creek		11			59.20	59.20		9	9				2,079
North Fork of Clearwater River		8			27.20	27.20		9	9				959
Pierce		45			1,527.80	1,527.80		403	403				53,785
Custer County:													
Alder Creek	6		404	14.20		14.20	3,543		3,543	22,011	101,174		9,920
Bay Horse	3		25,144	40.60		40.60	115,996		115,996	12,543	1,287,391		151,634
East Fork	1		(1)	(1)		(1)	(1)		(1)		(1)		(1)
Loon Creek		2			7.20	7.20							252
Rough Creek		2			13.40	13.40							469
Salmon River		1			2.40	2.40							84
Seafoam	1		(1)	(1)		(1)							(1)
Stanley and Stanley Basin	2	5	6	11.20	51.20	62.40	18	18	36				2,212
Yankee Fork	11	6	594	207.40	5.60	213.00	10,204		10,204	663	2,196		15,520
Elmore County:													
Bear Creek	7	2	162	44.80	6.20	51.00	18		18				1,799
Black Warrior	3		36	18.20		18.20	9		9				644
Boise River		9			27.00	27.00		9	9				952
Middle Boise	10	24	29,713	4,038.20	58.00	4,096.20	26,949	22	26,971	1,902			164,431
Pine Grove	2	2	2	3.00	1.60	4.60	4		4		22		165
Snake River		4			151.60	151.60		9	9				5,313
Volcano	1		(1)	(1)		(1)	(1)		(1)	(1)	(1)		(1)
Gem County: West View	5	8	121	114.40	68.80	183.20	186	13	199		717		6,599
Gooding County: Snake River		6			10.00	10.00							350
Idaho County:													
Blacktail		1			6.00	6.00							210
Camp Howard		63			865.20	865.20		133	133				30,385
Clearwater River		3			7.80	7.80							273
Deep Creek		1			2.80	2.80							98
Dixie	11	8	1,299	339.80	1,150.40	1,490.20	213	226	439	109	1,348		52,569
Elk City	8	17	1,031	207.20	1,056.60	1,263.80	106	204	310				44,473
Florence	5	18	153	25.20	136.40	161.60	9	58	67				5,708
Lolo Creek		2			1.20	1.20							42
Lower Salmon River		20			154.40	154.40		31	31				5,428
Maggie and Pete King Creeks		4			10.40	10.40		4	4				367
Marshall Lake	5	7	8,245	7,061.80	7.80	7,069.60	17,774		17,774	750	1,609		261,345
Newsome	1	3	(1)	(1)	16.60	16.60	(1)		(1)				1,799
Orogrande	7	4	96,145	5,122.20	70.80	5,193.00	2,062	18	2,080	250	1,717		183,468
Proctor Creek		1			36.40	36.40		9	9				1,281
Robbins	5		4,500	443.60		443.60	1,534		1,534	250	2,087		16,833
Salmon River		15			44.80	44.80		13	13				1,578
Simpson		43			187.20	187.20		40	40				6,583
Snake River		2			13.60	13.60							476
Ten Mile	4	7	5,758	1,644.40	73.00	1,717.40	692	18	710				60,659
Warren	4	10	3,622	777.60	9,461.80	10,239.40	1,623	4,040	5,663	54	435		362,790
Jerome County: Snake River		39			196.00	196.00		13	13				6,870

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1935–36, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
1936—Continued			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Latah County:													
Gold Creek		2			2.80	2.80							$98
Hoodoo		7			30.00	30.00		5	5				1,054
Moscow Mountain		2			14.20	14.20		4	4				500
Lemhi County:													
Blackbird	1		(1)	(1)		(1)	(1)		(1)				(1)
Blue Wing	1		(1)	(1)		(1)	(1)		(1)	(1)	(1)		(1)
Eureka	2	7	11	12.80	72.60	85.40		9	9	43			3,000
Gibbonsville	5	4	4,320	955.00	309.40	1,264.40	590	18	608	2,663			44,970
Indian Creek	1		(1)	(1)		(1)	(1)		(1)	(1)			(1)
Junction	3		102	4.00		4.00	5,867		5,867	424	53,761		7,196
Kirtley Creek		7			15.60	15.60		4	4				549
McDevitt	3		4,005	349.80		349.80	1,255		1,255	117,065			23,985
Mackinaw	1	17	(1)	(1)	174.80	[2] 174.80	(1)	18	[2] 18				9,173
Mineral Hill	5		6,238	1,257.60		1,257.60	745		745	337	4,391		44,826
Parker Mountain	1		(1)	(1)		(1)	(1)		(1)				(1)
Pratt Creek	2		703	281.60		281.60	816		816	652	17,000		11,330
Salmon River		19			91.60	91.60		18	18				3,220
Texas	6		1,294	79.40		79.40	15,140		15,140	4,370	855,826		54,275
Yellow Jacket	5	3	2,088	194.80	33.60	228.40	244	4	248	1,598	1,413		8,398
Nez Perce County:													
Clearwater River		1			1.00	1.00							35
Eagle Creek		1			8.40	8.40							294
Snake River		5			19.60	19.60							686
Owyhee County:													
Carson	17	3	1,151	326.80	3,117.40	3,444.20	5,069	1,978	7,047	54	717		126,043
Castle Creek	6		19	9.00		9.00	1,747		1,747		370		1,685
Flint	1		(1)	(1)		(1)	(1)		(1)				(1)
Snake River		19			525.20	525.20		31	31				18,406
Steele	1		(1)	(1)		(1)	(1)		(1)				(1)
Power County: Snake River		6			51.20	51.20		4	4				1,795
Shoshone County:													
Beaver	1	8	(1)	(1)	41.80	[2] 41.80	(1)	[2] 9	[2] 9	(1)	(1)	(1)	68,095
Coeur d'Alene	1	39	(1)	(1)	283.80	[2] 283.80	(1)	[2] 53	[2] 53				11,241
Eagle	1	1	(1)	(1)	4.80	[2] 4.80	(1)			(1)	(1)	(1)	43,366
Evolution	2		215,998	275.20		275.20	9,107,707		9,107,707	1,701,728	846,913		7,259,068
Hunter	4		484,186	457.80		457.80	1,254,155		1,254,155	235,609	59,995,630	49,341,280	6,235,905
Lelande	4		264,328	372.20		372.20	1,240,541		1,240,541	194,848	45,173,217	5,762,900	3,357,865
Placer Center	2		967	2.00		2.00	13,029		13,029	1,304	317,022	17,760	25,752
St. Joe		2			63.60	63.60		9	9				2,233

Summit	1	21	(1)	(1)	94.80	[2] 94.80	(1)	18	[2] 18	(1)	(1)		6,517
Yreka	9		471,853	759.40		759.40	2,112,847		2,112,847	486,978	65,882,500	32,450,900	6,360,921
Twin Falls County: Snake River		58			103.80	103.80		9	9				3,640
Valley County:													
Big Creek	1	3	(1)	(1)	32.80	[2] 32.80	(1)	4	[2] 4	(1)	(1)		1,428
Deadwood Basin	2		5	14.80		14.80	22		22				535
Gold Fork		1			3.00	3.00							105
Lake City		2			8.80	8.80							306
Payette River		1			1.60	1.60							56
Pistol Creek	2		74	170.00		170.00	1,091		1,091		11,000		7,301
Seafoam		1			3.20	3.20							112
Secesh		1			.80	.80							28
South Fork of Salmon River		1			1.80	1.80							63
Thunder Moutain	1	5	(1)	(1)	137.60	[3] 137.60	(1)	89	[3] 89				10,326
Yellow Pine	2		43,326	7,802.80		7,802.80	32,816		32,816	1,924	87		298,695
Washington County:													
Heath	1		(1)	(1)		(1)	(1)		(1)	(1)			(1)
Washington	1		(1)	(1)		(1)	(1)		(1)	(1)	(1)		(1)
Undistributed [3]			25,601	1,512.00		1,512.00	46,373		46,373	45,240	1,309,609	1,067,940	82,385
Total Idaho	281	828	1,807,530	45,861.60	34,429.80	80,291.40	14,526,377	11,153	14,537,530	2,954,000	182,678,000	98,200,000	27,654,472

[1] Included under "Undistributed."
[2] Exclusive of lode output, which is included under "Undistributed."
[3] Includes items entered as "1" and "2" above.

ADA COUNTY

Nearly all the output in Ada County in both 1935 and 1936 was placer gold recovered from sand and gravel from the Snake River and Highland (Boise River) districts; production in 1936 was considerably more than in 1935 due to the operation of a power shovel and dragline by the Gold Flour Mining Co. on the north bank of the Snake River adjacent to Grand View.

ADAMS COUNTY

Seven Devils district.—The output of metals from the Seven Devils district has been comparatively small for several years, but in 1935 the district became an important producer of gold due to the discovery of high-grade gold ore at the Placer Basin property 40 miles northwest of Council. The property continued to produce rich gold ore in 1936, and besides 318 tons of ore shipped to a smelter, about 600 tons of ore were milled in a 25-ton cyanidation plant.

BLAINE COUNTY

Little Wood River district.—No ore was produced in the Little Wood River district in 1935; in 1936 several cars of lead-zinc ore from an ore dump near Muldoon were shipped to Midvale, Utah, for milling.

Mineral Hill district.—The total value of the metal output of the Mineral Hill district in 1936 was slightly less than in 1935. The chief output in both years was gold ore of smelting grade from the Happy Day, Golden Bell, and Lindy properties.

Vienna district.—The Vienna mine was leased to the Kimball Mining Syndicate in 1935, and 375 tons of silver ore were concentrated by flotation; besides silver the concentrates contained considerable gold and a little lead and copper. The property was idle in 1936.

Warm Springs district.—The value of the metal output of the Warm Springs district increased from $10,654 in 1935 to $994,818 in 1936 as a result of the operations of the Triumph, North Star, and West Shore mines. The properties were idle in 1934 and 1935, but the Hailey Triumph Mines Co. started operations in January 1936 and shipped about 38,000 tons of zinc-lead ore to Bauer and International, Utah, for milling. The Triumph mine, a large producer of silver, lead, and zinc from 1927 to 1930, was the largest producer in the county in 1936. The only output in 1935 worth mentioning was a little zinc-lead ore from waste dumps.

BOISE COUNTY

Boise Basin district (Centerville, Placerville, Idaho City, Pioneerville).—The Boise Basin district was the chief gold-producing area in Idaho in 1936, as the output from placer mines increased from 4,981.54 ounces in 1935 to 12,335.80 ounces in 1936; the output from lode mines in 1936 was 8,814.80 ounces, an increase of 967.40 ounces over 1935. The large increase in production from placer properties was due chiefly to the gain in gold recovered by floating bucket dredges. Two floating dredges were constructed in 1935, one by The Grimes Co. and the other by the Fisher-Baumhoff Co. (Wharton placer.) The Fisher-Baumhoff Co. constructed another floating dredge in 1936, and the Moores Creek Dredging Co. also constructed a floating dredge. The output of gold from the four dredges in 1936 was 11,020.46

ounces compared with 3,508.64 ounces from two dredges in 1935. Considerable gold was also recovered in both 1935 and 1936 by sluicing at the Gold Hill Placers. The Talache Mines, Inc., by far the largest producer of gold ore in the county, increased its output from 31,181 tons in 1935 to 39,387 tons in 1936; the ore was treated by amalgamation. The Come-Back Mining Co., an important producer of high-grade gold and silver ore in 1935, continued to ship high-grade ore in 1936.

Summit Flat district.—Operators of the Golden Cycle, Rock Creek, and Jessie properties east of Pioneerville produced 381 ounces of gold and 217 ounces of silver, a large increase over the output in 1935.

BONNER COUNTY

The largest output in Bonner County in both 1935 and 1936 was lead-silver ore from the Hope (Elsie K.) mine in the Pend d'Oreille district treated by flotation-concentration; the output in 1936 (about 10,000 tons) was more than double that in 1935. The old Hewer property in the Lakeview district was reopened in July 1935 by the Revlis Co., and several thousand tons of silver ore were treated by flotation-concentration. The mine continued to produce silver ore until July 1936, when it was closed.

BONNEVILLE COUNTY

The value of the metal production of Bonneville County was virtually the same in both 1935 and 1936; the entire output was placer gold and silver from the Mt. Pisgah district, chiefly from the McCoy Creek and Idaho Consolidated properties.

BOUNDARY COUNTY

The Idaho Continental mine in the Port Hill district continued to produce a little high-grade lead ore in both 1935 and 1936.

CAMAS COUNTY

The Little Smoky Dredging Co., operating a bucket dredge on Little Smoky Creek, was the largest producer of gold in Camas County in both 1935 and 1936, but its output of gold in 1936 was less than half that in 1935. The output of gold from lode mines in the county also decreased, as less gold ore was produced from the El Oro mine near Fairfield in the Skeleton Creek district.

CLEARWATER COUNTY

The Pierce district was the only important producing district in Clearwater County in both 1935 and 1936. Almost the entire output was placer gold, chiefly from dredging operations on Rhodes Creek. The Gold Dredging, Inc., operated its bucket dredge on Rhodes Creek both years, but the output of gold in 1936 was about 500 ounces less than in 1935. A new bucket dredge was worked in 1936 on Orofino Creek, Pierce district, by the Gold Creek Placer Co., but the gold production was not large as the company started operations late in the year.

CUSTER COUNTY

Alder Creek district.—The output of the Alder Creek district increased slightly in 1936 over 1935 as a result of the increase in output of lead-silver ore from the Bluebird mine 4 miles southwest of Mackay.

Bay Horse district.—The value of the metal output of the Bay Horse district increased from $55,876 in 1935 to $151,634 in 1936, due to the large increase in output of lead-silver ore from the property of the Clayton Silver Mines at Clayton. Nearly 25,000 tons of silver-lead ore were treated in 1936 in the company 50-ton flotation-concentration mill. The Ramshorn mine was also a fairly large producer of silver-lead ore in both years.

ELMORE COUNTY

Bear Creek district.—The output of gold in the Bear Creek district in 1936 was much less than that in 1935, as the Canada Gold Mines, Inc., the chief producer in 1935, was idle in 1936.

Middle Boise district.—The value of the metal output of the Middle Boise district decreased considerably—from $737,204 in 1935 to $164,431 in 1936—due to the closing of the Boise-Rochester mine in June 1936; the mine was the largest producer of gold in Idaho from 1932 to 1935, inclusive. While the property was operated in 1936, more than 29,000 tons of gold ore were treated by amalgamation and flotation-concentration compared with 78,036 tons of ore and old tailings treated in 1935. The Last Chance Mining Co., a new company operating property at Atlanta in 1936, was also a fairly large producer of gold. Considerable gold was recovered in both 1935 and 1936 by various placer operators along the Middle Fork of the Boise River and at King Hill on the Snake River.

Yankee Fork district.—The production of gold and silver in the Yankee Fork district in 1936 was more than in 1935 due to the increase in output of gold ore from the Bachelor Mountain and Peak claims and to the output of silver ore from the Yankee Fork mine. Most of the output in 1935 was old tailings (gold) from the Sunbeam dump treated by cyanidation and concentration; the property was idle in 1936.

GEM COUNTY

The value of the metal output of Gem County increased from $2,268 in 1935 to $6,599 in 1936 as a result of the increase in production of gold ore from the Black Rock mine and placer gold from the Gattfield property, both in the West View district.

IDAHO COUNTY

Camp Howard (Salmon River) district (White Bird).—The output of gold recovered from various bars along the Salmon River from Riggins to beyond Rice Creek increased from 611.00 ounces in 1935 to 865.20 ounces in 1936. In 1936 the Horseshoe Bend Bar near the mouth of Slate Creek, operated by a power shovel and dragline, was by far the most important producer in the district.

Dixie district.—The value of the metal output of the Dixie district increased from $15,334 in 1935 to $52,569 in 1936 due chiefly to the large increase in the output of gold from the Dixie Placers. The company was organized in April 1935 to work placer claims on Crooked

Creek, a tributary of Salmon River, and in 1936 a dragline with trommel washing plant handled 192,000 cubic yards of gravel. The output of gold from lode mines also increased as several hundred tons of gold ore from the Dixie Comstock property were treated by flotation-concentration.

Elk City district.—The production of gold in the Elk City district increased from 865.46 ounces in 1935 to 1,263.80 ounces in 1936 due chiefly to increases in output of placer gold from the Deadwood claim and lode gold from the Black Lady (Pilot Knob Gold Corporation) mine. The Mount Vernon Co., operating a bucket dredge at the Deadwood property, was by far the largest producer of gold in the district in both 1935 and 1936. Considerable gold was also recovered in both 1935 and 1936 from placer operations at the Columbus, Gold Hill & American Hill, and Little Million properties. The only important lode producer in the district in 1936 was the Pilot Knob Gold Corporation; the company constructed a new 25-ton cyanide mill and treated about 900 tons of gold ore.

Florence district.—There were several placer and lode operators in the Florence district in 1935 and 1936, but the chief source of gold in both years was sluicing operations at the Homestake Placers.

Lower Salmon River district.—The entire output of the Lower Salmon River district in 1935 and 1936 was placer gold, chiefly from many transient operators near Keuterville and Boles. Most of the output in both years came from the Hatke claim near Keuterville.

Marshall Lake district (Burgdorf).—The value of the metal output of the Marshall Lake district increased from $64,247 in 1935 to $261,345 in 1936 as a result of the large increase in output of gold ore from the Golden Anchor (Holte) mine. The Golden Anchor Mining Co. constructed a 50-ton amalgamation and flotation plant during the summer of 1935 and became an important producer of gold. In 1936 it was the largest producer of gold in the county and ranked second among the gold producers of the State. The Walker-Wilcox group, a fairly large producer of gold ore in 1934 and 1935, was idle in 1936.

Newsome district.—The chief output in both 1935 and 1936 was low-grade gold ore from the Imogene mine treated by amalgamation.

Orogrande district.—The value of the metal output of the Orogrande district in 1936 was $183,468 compared with $113,976 in 1935. Most of the output in 1935 and 1936 was gold ore from the Orogrande-Frisco and Gnome properties treated by cyanidation; there was a substantial increase in the production of gold from each property in 1936. Low-grade gold ore (90,000 tons) from the Orogrande-Frisco property was mined by steam shovel from open-cuts and treated in a 500-ton cyanide plant. The Homestake mine operated by the Penman Mines Corporation was also a large producer of gold ore in 1935, but its output decreased considerably in 1936. More placer gold was produced in the district in 1936 than in previous years; most of it came from the Baker Gulch and Triangle claims.

Robbins (Buffalo Hump) district.—The production of gold from the Robbins district in 1936 was slightly less than that in 1935, as the output of gold ore from the War Eagle property was less. A large part of the output in both years was old tailings (gold) from the Jumbo dump treated by cyanidation.

Salmon River district.—Considerable placer gold was recovered by various operators in both 1935 and 1936 along the main Salmon River between Riggins and Proctor Creek.

Simpson (Salmon River) district (Lucile).—The value of gold output of the Simpson district in 1936 was about half that in 1935 as the McKinley mine, an important producer of lode gold in 1935, was idle in 1936; the output of placer gold was much less than in 1935.

Ten Mile district (Golden).—The Lone Pine mine was, as usual, the largest producer of ore in the Ten Mile district, but its output in 1936 was less than in 1935, consequently the total value of the metal output of the district was less. The mine produced 4,643 tons of gold ore in 1936 compared with 5,512 tons in 1935. The Shamrock mine was also an important producer of gold ore in both 1935 and 1936, and the Black Bird mine became an important producer in 1936. There were several placer operators in the district in both 1935 and 1936, but the chief production came from the Key claim.

Warren district.—The output of gold from the Warren district decreased from 16,143.06 ounces in 1935 to 10,239.40 ounces in 1936 due to the closing in December 1935 of the floating bucket dredge operated by the Warren Creek Dredging Co. and the large decline in production of gold from the two floating bucket dredges operated by the Idaho Gold Dredging Co. The Baumhoff-Fisher Co., a new producer in the district in 1936, operated a floating bucket dredge on Steamboat Creek; the combined output of gold from the three dredges in 1936 was about 9,300 ounces compared with 15,565 ounces in 1935. A fair amount of placer gold was also produced in both 1935 and 1936 from the Golden Rule claim. The production of gold from lode mines in the district increased considerably in 1936 owing to the large increase in output of gold ore from the Little Giant property operated by the Unity Gold Production Co. The property was operated throughout the year, and about 3,500 tons of gold ore were treated by amalgamation and concentration.

JEROME COUNTY

The entire metal output of Jerome County in both 1935 and 1936 was placer gold and silver recovered from various bars along the Snake River. The production of gold in 1936 was nearly double that in 1935.

LATAH COUNTY

The entire metal output of Latah County in both 1935 and 1936 was placer gold and silver from claims in the Gold Creek, Hoodoo, and Moscow Mountain districts. The chief producer in 1935 was the Rex claim and in 1936 the Annie Marie claim, both in the Hoodoo district.

LEMHI COUNTY

Blackbird district.—The Meadow mine near Forney was the only producer in the Blackbird district in 1935 and 1936; the output of high-grade gold ore was less in 1936 than in 1935.

Blue Wing district.—All the output of the Blue Wing district in both 1935 and 1936 was tungsten-silver-copper ore from the Ima property 15 miles northeast of May, treated in a 100-ton flotation-concentration plant.

Eureka district.—Nearly all the output of the Eureka district in both 1935 and 1936 was placer gold, chiefly from the McNutt claim.

Gibbonsville district.—The total value of the metal output of the Gibbonsville district increased from $8,752 in 1935 to $44,970 in 1936, due chiefly to the treatment of several thousand tons of gold ore in a 50-ton flotation-concentration plant by the Gold Producers, Inc. The company constructed the plant late in 1935 to treat custom ore from various mines in the county, but nearly all the ore treated in 1936 came from properties in the Gibbonsville district. The Clara Morris property was an important producer of high-grade gold ore in 1935 and 1936, and the Sundown placer claim became an important producer of gold in 1936 under the operation of the North Fork Placers Co.

Indian Creek district.—The output of gold in the Indian Creek district in 1936 was more than three times that in 1935, as there was a large increase in the production of gold ore from the Kittie Burton & Ulysses group. The Indian Creek Mining Co., Inc., operated the property throughout the year and treated several thousand tons of gold ore by flotation-concentration.

Junction district.—The output of silver and lead increased in the Junction district in 1936 due to shipments of silver-lead ore from the Plymouth mine near Leadore.

McDevitt district.—The Copper Queen mine near Tendoy was virtually the only producer in the McDevitt district in 1935 and 1936. The mine was operated by the Tendoy Copper Queen Mining Co., and the output of gold ore (containing appreciable quantities of silver and copper) in 1936 was more than double that in 1935; about 4,000 tons of ore were treated in 1936 by amalgamation and concentration.

Mackinaw district.—The output of gold from both lode and placer mines in the Mackinaw district in 1936 was slightly less than in 1935; most of the output in both years was placer gold, chiefly from the K. G. W. and Big Jureano claims. The chief production from lode mines in 1935 was first-class lead ore from the Ringbone Cayuse mine containing considerable gold, and in 1936 the entire output from lode mines was gold ore from the Shoo Fly mine.

Mineral Hill district.—The value of the metal output of the Mineral Hill district decreased from $55,969 in 1935 to $44,826 in 1936. The Grunter mine, operated by the American Consolidated Mining & Milling Co., was a large producer of gold ore in 1935, but the property has been idle since August 1935, when a fire destroyed the 100-ton concentration plant. The Gold Hill Mines, Inc., constructed a new 100-ton flotation-concentration plant in 1935 and treated a few thousand tons of gold ore from the old Kentuck & Speculation groups. The company increased its output in 1936 and became the largest producer of gold in the county.

Pratt and Sandy Creeks district.—The Gem mine on Sandy Creek was an important producer of gold ore in 1936; the output of ore in the district in 1935 was small.

Salmon River district.—Many placer operators worked bars along the Salmon River west of Salmon in 1936, and the total value of the gold output was about $3,200 in 1936 compared with $5,462 in 1935.

Texas district.—The value of the metal output of the Texas district increased from $14,082 in 1935 to $54,275 in 1936 as a result of the

large increase in shipments of lead-silver ore from the Latest Out mine near Gilmore.

Yellow Jacket district.—The increase in the output of gold in the Yellow Jacket district in 1936 was due chiefly to the treatment of low-grade gold ore from the Yellow Jacket mine near Forney by flotation-concentration. Placer gold recovered from Yellow Jacket Creek was valued at $1,176.

NEZ PERCE COUNTY

Most of the output in Nez Perce County in both 1935 and 1936 was placer gold recovered from various bars along the Snake River.

OWYHEE COUNTY

Carson district (Silver City, De Lamar).—The value of the metal output of the Carson district increased from $53,800 in 1935 to $126,043 in 1936 as a result of the operation of a bucket dredge on Jordan Creek near De Lamar by the Jordan Creek Placers. The dredge started operating July 25, 1935, and its output of gold in 1936 was more than double that in 1935. The output of gold from lode mines increased from 149.80 to 326.80 ounces. There were 17 lode mines producing in the district in 1936, but only 2 were important producers—the Ida Bell (Idaho Exploration, Inc.) and Potosi mines, both producers of gold ore.

Castle Creek district.—Several small lots of exceptionally rich silver ore were produced from the Castle Creek district in both 1935 and 1936.

Snake River district.—Placer gold recovered from claims along the Snake River in Owyhee County was valued at $18,382 in 1936 compared with $22,496 in 1935. The largest producer in both years was the Valley Pride property at Grand View, but its output of gold in 1936 was only half that in 1935.

POWER COUNTY

The total value of placer gold and silver recovered from various claims along the Snake River near American Falls was $1,795 in 1936 compared with $2,581 in 1935.

SHOSHONE COUNTY

COEUR D'ALENE REGION

Mine production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region, Shoshone County, Idaho, 1935–36, and total, 1884–1936, in terms of recovered metals

Year	Lode mines	Placers	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
			Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1935	28	76	1,237,244	2,714.00	9,892,910	1,974,458	156,580,100	62,017,841	$16,361,388
1936	25	71	1,454,987	2,454.40	13,740,222	2,629,511	173,267,391	88,620,840	23,370,963
Total, 1884–1936			(1)	358,452.33	306,283,361	[2] 45,714	[2] 4,687,373	[2] 557,892	799,834,478

[1] Figures not available.
[2] Short tons.

The Coeur d'Alene region has been the largest producing area in Idaho for many years. In 1936 mines in this region produced more than 80 percent of the total ore output of the State, 94 percent of the silver, 89 percent of the copper, 95 percent of the lead, and 90 percent of the zinc. More than 65 percent of the total ore produced from mines in the region in 1936 was lead-zinc ore, 18 percent was lead ore, and 16 percent was silver ore.

Beaver district.—Only 21 tons of ore were produced in the Beaver district in 1935, but in 1936 about 13,000 tons of zinc-lead ore from old waste dumps of the Interstate-Callahan property were treated in the Galena flotation plant. The remainder of the district output was placer gold and silver chiefly from Potosi Gulch.

Coeur d'Alene district.—Placer gold recovered by drift mining at old claims owned by the Coeur d'Alene Placer Co. was valued at $7,127 in 1936 compared with $9,933 in 1935; the chief producers in both years were the Nugget Gulch Leasing Co. and the Beehive Bar.

Eagle district.—The Jack Waite mine, a large producer of lead-zinc ore, lies in both Shoshone County, Idaho, and Sanders County, Mont. The entire production in both 1934 and 1935 came from Sanders County, but in 1936 part of the output (about 4,000 tons) came from the Eagle district in Shoshone County, and as a result the district again became a large producer of zinc and lead.

Evolution district.—The total value of the metal output of the Evolution district in 1936 was $7,259,068, the largest of any district in Idaho; in 1935 the total value was $4,339,518. The entire output in both 1935 and 1936, except a little silver ore from the Polaris mine in 1936, was silver ore from the Sunshine mine concentrated by flotation. The mine and mill were operated continuously, and 215,949 tons of ore were treated in 1936 compared with 160,417 tons in 1935. The concentrates in 1936 contained 9,103,113 ounces of silver, as well as some gold, copper, and lead, an unusually large increase over the 5,876,910 ounces of silver contained in concentrates in 1935. The property continued to be the largest producer of silver in the United States.

Hunter district (Mullan).—The output of all metals in the Hunter district increased decidedly in 1936 over 1935 as a result of the increase in output of lead-zinc ore from the Star and Morning mines. The Star mine, idle in 1934, was reopened on a production basis late in 1935 and continued producing at a limited rate throughout 1936; about 116,500 tons of ore containing chiefly zinc and lead were treated in the Hercules flotation plant. The Morning mine, as usual, was the most important producer in the district and the largest producer of zinc in the State. The mine and 1,200-ton flotation-concentration mill were operated continuously on a 5-day-week basis, and 313,866 tons of lead-zinc ore were treated. Lessees continued to operate the Gold Hunter mine, and the output of silver and lead was considerably more in 1936 than in 1935; about 46,000 tons of lead-silver ore were treated in 1936 in a 500-ton flotation plant. The output of zinc-lead ore from the Golconda mine decreased decidedly—from 17,643 tons in 1935 to about 6,000 tons in 1936; the property was operated under lease in 1936 by the Trinum Co.

Lelande district (Burke, Mace, Frisco).—The value of the metal output of the Lelande district increased from $2,863,762 in 1935 to $3,357,865 in 1936 owing chiefly to the increase in output of silver and

lead from the Hecla mine. The Hecla Mining Co. operated its mine and mill continuously on a 5-day-week basis, shipped 13,135 tons of first-class silver-lead ore to a smelter, and treated 204,839 tons of similar ore by gravity- and flotation-concentration. The mine ranked second in the production of silver in the State and third in lead. The next important producer in the district in both 1935 and 1936 was the Frisco mine, operated under lease by the Hull Leasing Co.; several thousand tons of zinc-lead ore were treated by flotation-concentration, and the production of zinc and lead in 1936 was much more than that in 1935. Almost all the remainder of the district output in both 1935 and 1936 was old tailings from Canyon Creek containing chiefly zinc.

Placer Center district.—The chief output of the Placer Center district in both 1935 and 1936 was lead-silver ore from the Dayrock mine operated by lessees.

St. Joe district.—Placer gold recovered from claims in the St. Joe district was valued at $2,226 in 1936 compared with $1,547 in 1935; nearly all the output in both years came from the Gold Producer claim on Bostonian Creek.

Summit district (Murray).—The Idaho Mother Lode Gold Mines, Inc., was the only lode producer in the Summit district in 1935 and 1936, and the production of gold in each year was about the same. Several placer operators in the district in both 1935 and 1936 recovered considerable gold from various claims owned by the Coeur d'Alene Placer Co.

Yreka district (Kellogg).—The total value of the metal output of the Yreka district increased from $4,723,376 in 1935 to $6,360,921 in 1936, due chiefly to the increase in production of lead and zinc from the Bunker Hill, Page, and Sidney mines and silver from the Crescent mine. The Bunker Hill property was, as usual, the most important producer in the district and the largest producer of lead in the State; its production of zinc has been increasing each year since 1931. The property was operated continuously in both 1935 and 1936 on a 5-day-week basis, and 348,463 tons of lead-zinc ore were treated in 1936 in concentration plants—part by flotation and part by gravity-concentration and flotation. The Page mine, operated by the Federal Mining & Smelting Co., was the next important producer in the district; its output of lead-zinc ore increased from 58,972 tons in 1935 to 71,100 tons in 1936. The output of the Crescent mine in 1936 was 16,788 tons of silver ore treated by flotation and 2,053 tons of high-grade silver ore smelted; its production of silver was about double that in 1935. The Sidney Leasing Co. operated the Sidney mine throughout the year and 25,618 tons of zinc-lead ore were treated in the Sweeny custom mill; the mine was reopened in October 1935 after being idle for 3 years. The remainder of the district output in 1935 and 1936 was chiefly lead-zinc ore from the Blackhawk mine and silver ore from the Caledonia mine.

TWIN FALLS COUNTY

The entire metal output of Twin Falls County in both 1935 and 1936 was placer gold and silver recovered from various bars along the Snake River near Twin Falls, Kimberly, and Hansen. The value of the output decreased from $4,394 in 1935 to $3,140 in 1936.

VALLEY COUNTY

Big Creek (Edwardsburg) district.—Nearly all the output in the Big Creek district in 1935 was gold ore from the Snow Shoe mine treated by amalgamation and concentration; most of the output in 1936 was placer gold recovered from the Smith Creek property.

Pistol Creek district.—The Pistol Creek district became a new producing area in Idaho in 1935 through the discovery of lead ore, rich in gold and silver, at the Lucky Boy mine 15 miles east of Landmark; a few cars of ore were shipped to a smelter in Utah. The property continued to produce in 1936, but the output was much less. The chief output of the district in 1936 was high-grade gold ore from the Cougar group.

Thunder Mountain district.—The Sunnyside mine at Stibnite, the only lode producer in the Thunder Mountain district, was sold late in 1935 to the Thunder Mountain Mining & Milling Co. The property was operated in 1935 by the Sunnyside Mining & Milling Co., which treated 2,340 tons of gold ore by amalgamation and concentration. The output in 1936 was much less than that in 1935. Nearly half the gold produced in the district in 1936 was recovered from placer claims.

Yellow Pine district.—The output of ore and the production of gold in the Yellow Pine district in 1936 were less than in 1935, as there was a decline in the production of ore from the Meadow Creek property, virtually the only producer in the district. The Yellow Pine Co. operated the property continuously in both years, and several thousand tons of ore containing chiefly gold and antimony were treated in a 200-ton flotation-concentration plant; the resulting concentrates, including antimony, were shipped to a smelter in Utah.

WASHINGTON COUNTY

Nearly all the metal output of Washington County in both 1935 and 1936 was first-class silver ore from the Silver Still property near Mineral in the Washington district. The Silver Still Mining Co. operated the mine throughout both years; the output of ore and its metal content in 1936 were about the same as in 1935.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN MONTANA[1]

(MINE REPORT)

By T. H. Miller

SUMMARY OUTLINE

The output of gold, silver, copper, lead, and zinc from Montana ores and gravels in 1936, in terms of recovered metals, was estimated at 181,100.00 fine ounces of gold, 11,585,600 fine ounces of silver, 219,104,000 pounds of copper, 38,238,000 pounds of lead, and 99,246,000 pounds of zinc. These figures are subject to revision after compilation of the final tabulations. This output compared with a production in 1935 of 151,088.03 fine ounces of gold, 9,322,951 fine ounces of silver, 154,957,470 pounds of copper, 31,177,525 pounds of lead, and 109,561,477 pounds of zinc. There were 681 lode mines and 551 placers operating in Montana in 1935; in 1936 the number of operating lode mines was about the same as in 1935, but the number of placers decreased.

From 1904 to 1935, inclusive, the total output from Montana mines was as follows: Ore, 141,355,586 short tons; gold, 4,102,697.68 fine ounces; silver, 353,669,643 fine ounces; copper, 7,353,415,798 pounds; lead, 626,001,773 pounds; and zinc, 2,907,683,034 pounds. The total value of the output from 1904 to 1935, inclusive, is $1,756,196,983; the value of the 1936 output is estimated at $42,190,363, and the total value of the output from 1862 to 1936 is estimated at $2,897,407,045.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the prices given in the table that follows. Gold in 1932 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1837, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95 per ounce, the yearly average weighted United States Government price[2]; and in 1935 and 1936 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1932 and 1933 is the average New York price for bar silver; in 1934, the Treasury buying price ($0.64646464+per ounce) for newly mined silver; and in 1935 and 1936, the yearly average weighted Treasury buying price for newly mined silver. The copper, lead, and zinc prices are weighted yearly averages of all grades of primary metal sold by producers.

[1] Figures for 1936 are preliminary; detailed data with final revisions will be released later.
[2] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Prices of gold, silver, copper, lead, and zinc, 1932–36

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[1] $20.67+	$0.282	$0.063	$0.030	$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050

[1] $20.671835. [2] $0.64646464.

To continue annual detailed statistics for Montana on mine production, classes of ore, methods of recovery of metals, and mining districts, the data for 1935 not available for inclusion in Minerals Yearbook, 1936, are supplied in this chapter.

Mine production of gold, silver, copper, lead, and zinc in Montana, 1932–36, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1932	390	232	765, 014	40, 602. 01	$839, 318	1, 686, 213	$475, 512
1933	426	276	862, 486	57, 822. 20	1, 477, 935	2, 660, 700	931, 245
1934	583	654	1, 066, 952	97, 445. 95	3, 405, 736	4, 006, 468	2, 590, 040
1935	681	551	2, 412, 113	151, 088. 03	5, 288, 081	9, 322, 951	6, 700, 871
1936 [1]	(2)	(2)	3, 738, 800	181, 100. 00	6, 338, 500	11, 585, 600	8, 973, 047

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1932	84, 847, 349	$5, 345, 383	2, 157, 766	$64, 733	4, 393, 034	$131, 791	$6, 856, 737
1933	65, 476, 375	4, 190, 488	13, 163, 432	487, 047	41, 448, 905	1, 740, 854	8, 827, 569
1934	63, 265, 000	5, 061, 200	20, 010, 000	7[illegible]0, 370	61, 442, 256	2, 642, 017	14, 439, 363
1935	154, 957, 470	12, 861, 470	31, 177, 525	1, 247, 101	109, 561, 477	4, 820, 705	30, 918, 228
1936 [1]	219, 104, 000	20, 157, 568	38, 238, 000	1, 758, 948	99, 246, 000	4, 962, 300	42, 190, 363

[1] Subject to revision.
[2] Figures not yet available.

Gold and silver produced at placer mines in Montana, 1931–35, in fine ounces, in terms of recovered metals

Year	Sluicing		Dry-land dredges [1]		Floating dredges		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1931	1, 907. 86	233					1, 907. 86	233
1932	3, 537. 42	422					3, 537. 42	422
1933	4, 022. 86	500	1, 546. 49	275	3, 135. 73	448	8, 705. 08	1, 223
1934	5, 607. 71	686	4, 877. 79	889	15, 058. 39	1, 562	25, 543. 89	3, 137
1935	4, 586. 48	647	9, 031. 88	1, 554	12, 680. 87	1, 294	26, 299. 23	3, 495

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

Gold.—The output of recoverable gold from mines in Montana in 1936 was about 181,100.00 fine ounces compared with 151,088.03 in 1935 and 97,445.95 in 1934. Placer mines produced about 40,800.00 fine ounces of gold in 1936 compared with 26,299.23 in 1935, an increase of about 14,500 ounces, and gold mines increased about

15,500 ounces. Nearly all the increase in gold from placer mines in 1936 was from two dredges that started operations in 1935 and ran continuously during 1936—the floating dredge of Porter Bros. Corporation at Helena, which started operations in November 1935, and the dry-land dredge of Humphreys Gold Corporation at Virginia City. The floating dredge at Pioneer operated regularly in 1936, and its output of gold was about the same as in 1935; other operations included the Winston Bros. Co. plant on Prickly Pear Creek near Clancy and the Eldorado plant in Washington Gulch, Powell County. Small-scale placer operators produced about 4,500 ounces of gold in 1936, about the same as in 1935. Gold from lode mines increased from 124,789 ounces in 1935 to about 140,300 in 1936. Gold from copper ores and lead-zinc ores from Butte properties of the Anaconda Copper Mining Co. was more than double that in 1935, and there was a substantial increase at the Ruby Gulch property in Phillips County. Other large producers of gold in 1936 included the Gould, Spring Hill, Little Ben, Golden Messenger, and Comet mines, each of which produced more than 5,000 ounces of gold.

Silver.—The output of recoverable silver increased from 9,322,951 ounces in 1935 to about 11,585,600 in 1936. Nearly 68 percent of the silver came from copper ores and lead-zinc ores from the Butte district, most of which was produced by the Anaconda Copper Mining Co. Other large silver producers included the Trout, Comet, Flathead, and Granite Bimetallic mines. (Lead-zinc ore was the product of the Trout and Comet mines; siliceous silver ore was the product of the Flathead and Granite Bimetallic mines.) The Lone Pine & Argyle Silver mine in the Vipond district, Beaverhead County, was also an important silver producer in 1936.

Copper.—The Anaconda Copper Mining Co. at Butte as usual produced nearly all the State output of copper, which increased from 154,957,470 pounds, in terms of recoverable metal, in 1935 to about 219,104,000 pounds in 1936. In addition to the usual mining, milling, and smelting operations on copper ores, the Anaconda Copper Mining Co. reopened the sand-leaching plant at Anaconda and re-treated nearly 550,000 tons of old copper tailings by a combination of acid-leaching and flotation. Nearly all the remainder of the copper came from lead-zinc ores. Copper was by far the most important mineral product of Montana in 1936.

Lead.—The output of recoverable lead in 1936 was about 38,238,000 pounds compared with 31,177,525 in 1935. Lead-zinc ore from the Orphan Girl and Emma mines at Butte (operated by the Anaconda Copper Mining Co.) and the Jack Waite, Comet, and Trout mines yielded about 85 percent of the total output. Ore from these mines was treated at four selective flotation plants. The slag-fuming plant at East Helena, also operated by the Anaconda Copper Mining Co., was an important producer of lead in a zinc-lead fume sent to the Great Falls zinc-reduction plant.

Zinc.—The recoverable output of zinc decreased about 9 percent—from 109,561,477 pounds in 1935 to about 99,246,000 in 1936. About 67 percent of this zinc came from the Orphan Girl and Emma mines at Butte. Other important producers of zinc in 1936 were the Trout, Comet, and Josephine mines and the slag-fuming plant at East Helena. The Anaconda Copper Mining Co. operated the Orphan Girl and Emma mines and the slag plant at East Helena while the Josephine mine was operated by lessees from the company.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Montana in 1935, by counties, in terms of recovered metals

County	Mines producing			Ore	Gold						Silver					
					Lode		Placer		Total		Lode		Placer		Total	
	Lode	Placer	Total	Short tons	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Beaverhead	49	23	72	41,928	10,369.20	$362,922	81.00	$2,835	10,450.20	$365,757	255,705	$183,788	7	$5	255,712	$183,793
Broadwater	69	34	103	32,463	7,356.00	257,460	144.17	5,046	7,500.17	262,506	44,288	31,832	18	13	44,306	31,845
Carbon		4	4				6.77	237	6.77	237						
Cascade	18		18	3,614	30.80	1,078			30.80	1,078	29,632	21,298			29,632	21,298
Deer Lodge	25	13	38	15,432	2,975.20	104,132	45.80	1,603	3,021.00	105,735	7,552	5,428			7,552	5,428
Fergus	15	6	21	1,609	231.60	8,106	54.77	1,917	286.37	10,023	14,510	10,429	11	8	14,521	10,437
Flathead	2		2	18,279	2.00	70			2.00	70	537,888	386,607			537,888	386,607
Gallatin		1	1				2.20	77	2.20	77						
Granite	68	40	108	120,290	10,074.00	352,590	259.66	9,088	10,333.66	361,678	1,068,736	768,154	46	33	1,068,782	768,187
Jefferson	88	31	119	109,097	9,888.00	346,080	2,732.03	95,621	12,620.03	441,701	428,768	308,177	647	465	429,415	308,642
Judith Basin	3	2	5	59	1.40	49	7.97	279	9.37	328	1,134	815			1,134	815
Lewis and Clark	63	79	142	276,254	27,605.00	966,175	2,931.46	102,601	30,536.46	1,068,776	88,697	63,751	302	217	88,999	63,968
Lincoln	7	7	14	7,239	1,306.80	45,738	57.60	2,016	1,364.40	47,754	11,609	8,344	7	5	11,616	8,349
Madison	171	37	208	63,549	22,260.40	779,114	4,796.00	167,860	27,056.40	946,974	85,056	61,134	839	603	85,895	61,737
Meagher	1	10	11	58	32.60	1,141	73.97	2,589	106.57	3,730	25	18	18	13	43	31
Mineral	2	34	36	3	.20	7	330.00	11,550	330.20	11,557	96	69	14	10	110	79
Missoula	7	24	31	1,508	414.40	14,504	473.77	16,582	888.17	31,086	8,288	5,957	18	13	8,306	5,970
Park	7	20	27	45,271	6,967.40	243,859	832.00	29,120	7,799.40	272,979	1,863	1,339	139	100	2,002	1,439
Phillips	5	4	9	33,826	11,564.20	404,747	20.03	701	11,584.23	405,448	20,736	14,904	7	5	20,743	14,909
Powell	25	45	70	16,388	4,330.60	151,571	12,779.60	447,286	17,110.20	598,857	146,706	105,445	1,337	961	148,043	106,406
Ravalli	5	5	10	2,569	655.20	22,932	248.20	8,687	903.40	31,619	10,887	7,825	14	10	10,901	7,835
Sanders	2	2	4	11,229	33.20	1,162	73.23	2,563	106.43	3,725	9,543	6,859	14	10	9,557	6,869
Silver Bow	49	130	179	1,611,448	8,690.60	304,171	349.00	12,215	9,039.60	316,386	6,547,737	4,706,186	57	41	6,547,794	4,706,202
	681	551	1,232	2,412,113	124,788.80	4,367,608	26,299.23	920,473	151,088.03	5,288,081	9,319,456	6,698,359	3,495	2,512	9,322,951	6,700,871
Total, 1934	583	654	1,237	1,066,952	71,902.06	2,512,977	25,543.89	892,759	97,445.95	3,405,736	4,003,331	2,588,012	3,137	2,028	4,006,468	2,590,040

Mine production of gold, silver, copper, lead, and zinc in Montana in 1935, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value		
	Pounds	Value	Pounds	Value	Pounds	Value	Lode	Placer	Lode and placer
Beaverhead	61, 554	$5, 109	126, 850	$5, 074	2, 614	$115	$557, 008	$2, 840	$559, 848
Broadwater	7, 964	661	193, 000	7, 720	14, 068	619	298, 292	5, 059	303, 351
Carbon								237	237
Cascade	2, 398	199	63, 625	2, 545	3, 773	166	25, 286		25, 286
Deer Lodge	13, 590	1, 128	7, 975	319			111, 007	1, 603	112, 610
Fergus	241	20	1, 250	50			18, 605	1, 925	20, 530
Flathead							386, 677		386, 677
Gallatin								77	77
Granite	440, 699	36, 578	1, 981, 000	79, 240	9, 492, 250	417, 659	1, 654, 221	9, 121	1, 663, 342
Jefferson	248, 145	20, 596	2, 769, 800	110, 792	2, 151, 136	94, 650	880, 295	96, 086	976, 381
Judith Basin	241	20	44, 875	1, 795			2, 679	279	2, 958
Lewis and Clark	6, 566	545	2, 632, 925	105, 317	22, 193, 159	976, 499	2, 112, 287	102, 818	2, 215, 105
Lincoln	6, 000	498	215, 000	8, 600	182, 182	8, 016	71, 196	2, 021	73, 217
Madison	55, 361	4, 595	123, 100	4, 924			849, 767	168, 463	1, 018, 230
Meagher	36	3					1, 162	2, 602	3, 764
Mineral			1, 650	66			142	11, 560	11, 702
Missoula	51, 265	4, 255	9, 825	393			25, 109	16, 595	41, 704
Park	1, 880	156	300	12			245, 366	29, 220	274, 586
Phillips	518	43					419, 694	706	420, 400
Powell	32, 446	2, 693	159, 075	6, 363			266, 072	448, 247	714, 319
Ravalli	73, 289	6, 083	625	25			36, 865	8, 697	45, 562
Sanders	26, 289	2, 182	2, 241, 675	89, 667	230. 068	10, 123	109, 993	2, 573	112, 566
Silver Bow	153, 928, 988	12, 776, 106	20, 604, 975	824, 199	75, 292, 227	3, 312, 858	21, 923, 520	12, 256	21, 935, 776
	154, 957, 470	12, 861, 470	31, 177, 525	1, 247, 101	109, 561, 477	4, 820, 705	29, 995, 243	922, 985	30, 918, 228
Total, 1934	63, 265, 000	5, 061, 200	20, 010, 000	740, 370	61, 442, 256	2, 642, 017	13, 544, 576	894, 787	14, 439, 363

Gold and silver produced at placer mines in Montana in 1935, by counties, in fine ounces, in terms of recovered metals

County	Sluicing		Dry-land dredges [1]		Floating dredges		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Beaverhead	81.00	7					81.00	7
Broadwater	136.54	17	7.63	1			144.17	18
Carbon	6.77						6.77	
Deer Lodge	30.06		15.74				45.80	
Fergus	54.77	11					54.77	11
Gallatin	2.20						2.20	
Granite	259.66	46					259.66	46
Jefferson	234.39	69	2,497.64	578			2,732.03	647
Judith Basin	7.97						7.97	
Lewis and Clark	535.47	70	10.51	7	2,385.48	225	2,931.46	302
Lincoln	57.60	7					57.60	7
Madison	229.10	29	4,566.90	810			4,796.00	839
Meagher	73.97	18					73.97	18
Mineral	330.00	14					330.00	14
Missoula	177.41	12	296.36	6			473.77	18
Park	832.00	139					832.00	139
Phillips	20.03	7					20.03	7
Powell	1,083.75	130	1,400.46	138	10,295.39	1,069	12,779.60	1,337
Ravalli	11.56		236.64	14			248.20	14
Sanders	73.23	14					73.23	14
Silver Bow	349.00	57					349.00	57
	4,586.48	647	9,031.88	1,554	12,680.87	1,294	26,299.23	3,495
Total, 1934	5,607.71	686	4,877.79	889	15,058.39	1,562	25,543.89	3,137

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

MINING INDUSTRY

The marked increase in output of copper in both 1935 and 1936 was of especial interest to the mining industry in Montana. The output of copper ore from Butte has increased gradually since 1934, and the copper department of the Anaconda Copper Mining Co. was operating at near capacity at the end of 1936. The copper output in 1936 (219,104,000 pounds) was considerably larger than the average annual output (173,787,409 pounds) for the decade 1927–36. The increase in value of copper produced in 1936 compared with 1935 accounted for 65 percent of the total increase in value of State output of all five metals. There were also substantial increases in value of gold and silver produced, and copper ore was also responsible for most of these gains.

Activity continued at properties producing gold ore in 1936. New cyanide mills were constructed at the Ruby Gulch mine in Phillips County, and two new cyanide plants were built at properties near Argenta in Beaverhead County; gold mills at several other properties were reconditioned and enlarged.

ORE CLASSIFICATION

Ore sold or treated in Montana in 1935, with content in terms of recovered metals

Source	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold ore	455	437,467	104,142.26	270,435	179,241	362,300	----------
Dry gold and silver ore	34	35,532	5,777.21	241,498	59,815	297,075	----------
Dry silver ore	109	81,854	2,103.83	1,162,353	166,387	127,388	----------
	[1] 595	554,853	112,023.30	1,674,286	405,443	786,763	----------
Copper ore	8	1,259,892	2,704.24	4,350,353	152,949,955	----------	----------
Lead ore	84	9,085	1,101.25	81,384	14,028	1,071,633	----------
Zinc ore	1	123,441	----------	13,127	----------	2,478,550	22,156,886
Copper-lead ore	2	308	3.86	1,464	4,062	16,721	----------
Lead-zinc ore	17	464,534	8,956.15	3,198,842	1,583,982	26,823,858	87,404,591
Total, lode mines	[1] 681	2,412,113	124,788.80	9,319,456	154,957,470	31,177,525	109,561,477
Total, placers	551	----------	26,299.23	3,495	----------	----------	----------
	1,232	2,412,113	151,088.03	9,322,951	154,957,470	31,177,525	109,561,477
Total, 1934	1,237	1,066,952	97,445.95	4,006,468	63,265,000	20,010,000	61,442,256

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

Value of metals from ore sold or treated in Montana in 1935, by classes of ore

Class	Ore (short tons)	Gold	Silver	Copper	Lead	Zinc	Total value
Dry gold ore	437,467	$3,644,979	$194,375	$14,877	$14,492	----------	$3,868,723
Dry gold and silver ore	35,532	202,203	173,577	4,965	11,883	----------	392,628
Dry silver ore	81,854	73,634	835,441	13,810	5,096	----------	927,981
	554,853	3,920,816	1,203,393	33,652	31,471	----------	5,189,332
Copper ore	1,259,892	94,648	3,126,816	12,694,846	----------	----------	15,916,310
Lead ore	9,085	38,544	58,495	1,164	42,865	----------	141,068
Zinc ore	123,441	----------	9,435	----------	99,142	$974,903	1,083,480
Copper-lead ore	308	135	1,052	337	669	----------	2,193
Lead-zinc ore	464,534	313,465	2,299,168	131,471	1,072,954	3,845,802	7,662,860
Total, lode mines	2,412,113	4,367,608	6,698,359	12,861,470	1,247,101	4,820,705	29,995,243
Total, placers	----------	920,473	2,512	----------	----------	----------	922,985
	2,412,113	5,288,081	6,700,871	12,861,470	1,247,101	4,820,705	30,918,228
Total, 1934	1,066,952	3,405,736	2,590,040	5,061,200	740,370	2,642,017	14,439,363

Gold ore.—The output of gold ore in Montana in 1935 was 437,467 tons, a marked increase from 243,405 tons in 1934. Most of the increase was in ore to gold and silver mills, but there was a substantial increase in gold ore smelted. Of the total gold ore produced in 1935, 232,860 tons were treated at gold and silver mills, 147,048 tons were concentrated, and 56,489 tons were smelted. Mines in Lewis and Clark, Madison, and Park Counties produced about 60 percent of the total gold ore in 1935.

Gold and silver ore.—The output of gold and silver ore increased 31,158 tons in 1935; most of it came from the Emery mine in Powell County and the Jib mine in Jefferson County. About 75 percent of it was milled, and the rest was smelted.

Silver ore.—The output of silver ore more than doubled in Montana in 1935. Most of it came from the Granite Bimetallic and Combination mines in Granite County, the Flathead mine in Flathead County, and the Lone Pine & Argyle Silver mine in Beaverhead County. More than half the silver ore was milled; the rest was smelted.

Copper ore.—The output of copper ore in 1935 was nearly three times larger than that in 1934; as in the past, nearly all of it came from the Butte properties of the Anaconda Copper Mining Co., and most of it was treated by flotation concentration. Metals recovered from copper ore (including the value of copper in precipitates) were valued at $15,916,310, or about 51 percent of the total value of the State output.

Lead ore.—There were no large producers of lead ore in Montana in 1935, and the output was slightly less than that in 1934; most of the 1935 output was milled.

Zinc ore.—All the zinc material treated in Montana in 1935 was slag from the lead smelter at East Helena, treated in a fuming plant by the Anaconda Copper Mining Co.; the output was nearly twice that in 1934.

Lead-zinc ore.—The output of lead-zinc ore was nearly doubled in 1935. All of it was treated by flotation, and most of it came from the Orphan Girl and Emma mines at Butte, the Comet mine near Basin, and the Trout mine at Philipsburg.

Ore sold or treated in Montana in 1935, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaverhead	31,825	9,810.26	27,578	5,917	4,153	
Broadwater	31,382	6,863.17	30,065	7,080	94,344	
Cascade	20	15.46	5			
Deer Lodge	15,235	2,926.64	2,275	12,602	7,625	
Fergus	864	199.13	1,256			
Granite	25,650	7,443.16	6,426	6,483	275	
Jefferson	27,042	5,221.14	17,417	7,858	71,260	
Lewis and Clark	151,867	27,501.97	63,934	3,463	7,966	
Lincoln	5,839	1,305.46	10,265	4,530	106,875	
Madison	62,465	21,975.58	74,099	54,870	66,055	
Meagher	58	32.60	25	36		
Missoula	553	362.94	110	60		
Park	45,271	6,967.40	1,863	1,880	300	
Phillips	33,826	11,564.20	20,736	518		
Powell	702	512.59	2,541	137	2,822	
Ravalli	2,569	655.20	10,887	73,289	625	
Silver Bow	2,299	785.36	953	518		
	437,467	104,142.26	270,435	179,241	362,300	
Total, 1934	243,405	63,228.42	159,225	117,184	233,184	

DRY GOLD AND SILVER ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
Beaverhead	12	1.30	80	84	604	
Broadwater	22	5.20	308	71	850	
Deer Lodge	80	43.16	2,421	255		
Granite	91	17.00	1,184			
Jefferson	18,109	1,291.04	59,690	26,962	154,639	
Lewis and Clark	29	8.39	335	96	1,189	
Madison	913	226.81	6,328			
Powell	15,633	3,786.31	142,862	32,202	139,793	
Silver Bow	643	398.00	28,290	145		
	35,532	5,777.21	241,498	59,815	297,075	
Total, 1934	4,374	907.18	48,908	12,844	2,200	

Ore sold or treated in Montana in 1935, by counties, with content in terms of recovered metals—Continued

DRY SILVER ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaverhead	9,035	137.02	212,582	46,000	1,568	
Broadwater	489	22.50	9,005	163	6,075	
Cascade	187	8.40	5,913	627	4,623	
Deer Lodge	116	5.10	2,826	728	150	
Fergus	740	31.07	13,071	212		
Flathead	18,279	2.00	537,888			
Granite	48,507	1,474.79	298,333	115,772	70,984	
Jefferson	816	49.84	8,417	2,439	42,867	
Lewis and Clark	20	2.30	270	58	1,069	
Madison	75	2.00	2,547	230	52	
Silver Bow	3,590	368.81	71,501	158		
	81,854	2,103.83	1,162,353	166,387	127,388	
Total, 1934	40,049	749.64	399,730	29,437	77,701	

COPPER ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
Beaverhead	40	4.00	7	2,976		
Granite	6	7.00	480	885		
Jefferson	102	15.07	1,923	7,861		
Missoula	897	48.00	7,712	48,713		
Sanders	76	11.17	103	14,265		
Silver Bow	1,258,771	2,619.00	4,340,128	152,875,255		
	1,259,892	2,704.24	4,350,353	152,949,955		
Total, 1934	458,587	1,396.18	1,808,104	61,837,368		

LEAD ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
Beaverhead	990	416.26	15,099	6,519	118,456	
Broadwater	531	445.94	4,311	244	80,304	
Cascade	3,142	5.65	22,510	182	49,273	
Deer Lodge	1	.30	30	5	200	
Fergus	5	1.40	183	29	1,250	
Granite	5		88	3	2,010	
Jefferson	3,377	86.70	26,136	2,588	83,104	
Judith Basin	59	1.40	1,134	241	44,875	
Lewis and Clark	444	52.29	6,315	925	98,528	
Madison	96	56.01	2,082	261	56,993	
Mineral	3	.20	96		1,650	
Powell	53	31.70	1,303	107	16,460	
Sanders	377	3.20	2,065	2,924	517,505	
Silver Bow	2	.20	32		1,025	
	9,085	1,101.25	81,384	14,028	1,071,633	
Total, 1934	10,321	2,544.41	152,723	23,975	2,578,153	

ZINC ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
Lewis and Clark	123,441		13,127		2,478,550	22,156,886
	123,441		13,127		2,478,550	22,156,886
Total, 1934	65,913		6,944		1,352,189	13,464,977

COPPER-LEAD ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
Cascade	250	0.40	998	1,570	6,896	
Missoula	58	3.46	466	2,492	9,825	
	308	3.86	1,464	4,062	16,721	
Total, 1934	(1)					

LEAD-ZINC ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
Beaverhead	26	0.36	359	58	2,069	2,614
Broadwater	39	19.19	599	406	11,427	14,068
Cascade	15	.89	206	19	2,833	3,773
Granite	46,031	1,132.05	762,225	317,556	1,907,731	9,492,250
Jefferson	59,651	3,224.21	315,185	200,437	2,417,930	2,151,136
Lewis and Clark	453	40.05	4,716	2,024	45,623	36,273
Lincoln	1,400	1.34	1,344	1,470	108,125	182,182
Sanders	10,776	18.83	7,375	9,100	1,724,170	230,068
Silver Bow	346,143	4,519.23	2,106,833	1,052,912	20,603,950	75,292,227
	464,534	8,956.15	3,198,842	1,583,982	26,823,858	87,404,591
Total, 1934	244,303	3,076.23	1,427,697	1,244,192	15,766,573	47,977,279

[1] None produced in 1934.

Zinc products[1] *(as marketed from Montana mines and mills) sold to smelters and electrolytic plants in 1935*

Classification	County	Quantity (dry weight)	Gross zinc[1]	Average assay of concentrates	Recovered zinc[1]
		Short tons	*Pounds*	*Percent*	*Pounds*
Zinc concentrates	Beaverhead, Broadwater, Cascade, Granite, Jefferson, Lewis and Clark, Lincoln, Sanders, and Silver Bow.	85,326	96,115,969	56.32	87,404,591
		85,326	96,115,969	56.32	87,404,591
Total, 1934		49,907	53,375,271	53.47	47,977,279

[1] Exclusive of zinc recovered from the treatment of current slag at East Helena.

METALLURGIC INDUSTRY

Of the 2,412,113 tons of material produced in 1935 in Montana, 232,860 tons (9.65 percent) were treated at gold and silver mills, 1,924,826 tons (79.80 percent) were treated at concentration mills, 130,986 tons (5.43 percent) were shipped direct to smelters, and the rest (123,441 tons) was treated at a slag-fuming plant.

Of the total material treated at gold and silver mills, 4,757 tons were treated at straight amalgamation plants, 117,420 tons at straight cyanidation plants, and 110,683 tons at combined amalgamation or cyanidation and concentration plants. The following table summarizes operations at gold and silver mills in 1935.

Mine production of metals from gold and silver mills in Montana in 1935, by counties, in terms of recovered metals

County	Ore, old tailings, etc., treated (dry weight)		Recovered in bullion			
			Amalgamation		Cyanidation	
	Ore	Old tailings, etc.	Gold	Silver	Gold	Silver
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*
Beaverhead	17,407		3.55		4,343.90	3,833
Broadwater	14,333		203.06	38	2,606.24	10,716
Cascade	20		15.46	5		
Deer Lodge	12,552		829.39	17		
Fergus	716		38.55	32	5.64	12
Granite	18,281		136.95	47	2,357.00	66
Jefferson	3,103		267.80	35		
Lewis and Clark	67,459	500	8,419.62	35,008	6,098.79	4,134
Lincoln	4,839		859.60	211		
Madison	14,777	501	1,189.48	410	38.80	40
Meagher	20		2.10	11		
Missoula	300		73.91	10		
Park	45,267		4,251.18	735		
Phillips	32,665				7,426.40	9,165
Powell	46		66.32	12		
Ravalli	61		31.92			
Silver Bow	13		6.44	3		
	231,859	1,001	16,395.33	36,574	22,876.77	27,966
Total, 1934	130,495	5,029	7,754.09	3,925	12,677.19	32,779

Mine production of metals from gold and silver mills in Montana in 1935, by counties, in terms of recovered metals—Continued

County	Concentrates and recovered metal				
	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Deer Lodge	96	105.00	15	113	----------
Fergus	3	56.60	326	----------	----------
Granite	22	132.70	76	104	122
Lewis and Clark	61	1,225.25	6,937	----------	----------
Lincoln	184	425.20	9,995	4,326	105,141
Madison	119	832.07	6,806	2,133	10,615
Missoula	3	2.11	1	----------	----------
Park	1,121	2,712.78	1,114	1,880	300
Powell	4	13.30	40	----------	50
	1,613	5,505.01	25,310	8,556	116,228
Total, 1934	1,761	5,374.24	18,265	6,329	93,794

Of the 1,924,826 tons of material treated at concentration plants in 1935 in Montana, 1,239,285 tons (64.38 percent) were treated at a copper flotation plant, 464,534 tons were treated at lead-zinc flotation plants, and most of the remainder was siliceous ore (chiefly gold ore) treated by flotation.

Mine production of metals from concentrating mills in Montana in 1935, by counties, in terms of recovered metals

County	Ore and old tailings treated (dry weight)		Concentrates and recovered metal					
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaverhead	26	--------	5	0.36	359	58	2,069	2,614
Broadwater	11,119	--------	1,028	806.49	819	2,490	17,301	14,068
Cascade	3,115	250	119	5.39	22,436	1,618	52,781	3,773
Granite	86,931	--------	15,804	1,598.85	950,902	411,304	1,975,099	9,492,250
Jefferson	92,451	3,329	11,892	5,663.35	359,574	225,225	2,537,725	2,151,136
Lewis and Clark	77,644	1,000	4,679	8,169.05	7,471	4,876	51,317	36,273
Lincoln	2,400	--------	290	22.00	1,403	1,674	109,859	182,182
Madison	36,657	--------	2,233	7,336.20	16,322	37,854	21,171	----------
Powell	11,700	--------	1,300	1,146.90	27,103	147	2,479	----------
Sanders	10,776	--------	1,457	18.83	7,375	9,100	1,724,170	230,068
Silver Bow	1,587,428	--------	413,579	7,744.73	6,366,224	141,976,971	20,603,950	75,292,227
	1,920,247	4,579	452,386	32,512.15	7,759,988	142,671,317	27,097,921	87,404,591
Total, 1934	807,045	5,463	179,924	17,455.40	3,394,761	57,899,550	15,958,476	47,977,279

Gross metal content of Montana concentrates produced in 1935, by classes of concentrates

Class of concentrates	Concentrates produced (dry weight)	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	35,548	27,610.63	414,619	289,779	302,762	----------
Copper	315,085	2,638.00	4,330,322	144,109,057	----------	----------
Lead	18,020	3,334.87	1,016,418	852,736	22,789,062	----------
Zinc	85,326	4,433.26	2,022,941	756,805	5,391,945	96,115,969
Copper-lead	20	.40	998	1,963	7,221	----------
	453,999	38,017.16	7,785,298	146,010,340	28,490,990	96,115,969
Total, 1934	181,685	22,829.64	3,413,026	59,966,596	16,807,106	53,375,271

Mine production of metals from Montana concentrates in 1935, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaverhead	5	0.36	359	58	2,069	2,614
Broadwater	1,028	806.49	819	2,490	17,301	14,068
Cascade	119	5.39	22,436	1,618	52,781	3,773
Deer Lodge	96	105.00	15	113		
Fergus	3	56.60	326			
Granite	15,826	1,731.55	950,978	411,408	1,975,221	9,492,250
Jefferson	11,892	5,663.35	359,574	225,225	2,537,725	2,151,136
Lewis and Clark	4,740	9,394.30	14,408	4,876	51,317	36,273
Lincoln	474	447.20	11,398	6,000	215,000	182,182
Madison	2,352	8,168.27	28,128	39,987	31,786	
Missoula	3	2.11	1			
Park	1,121	2,712.78	1,114	1,880	300	
Powell	1,304	1,160.20	27,143	147	2,529	
Sanders	1,457	18.83	7,375	9,100	1,724,170	230,068
Silver Bow	413,579	7,744.73	6,366,224	141,976,971	20,603,950	75,292,227
	453,999	38,017.16	7,785,298	142,679,873	27,214,149	87,404,591
Total, 1934	181,685	22,829.64	3,413,026	57,905,879	16,052,270	47,977,279

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous	35,548	27,610.63	414,619	267,529	289,157	
Copper	315,085	2,638.00	4,330,322	141,009,938		
Lead	18,020	3,334.87	1,016,418	681,875	21,795,654	
Zinc	85,326	4,433.26	2,022,941	718,961	5,122,442	87,404,591
Copper-lead	20	.40	998	1,570	6,896	

The following table gives the total crude ore of smelting grade produced in Montana in 1935. In addition, 7,701 tons of old tailings, etc. (chiefly siliceous), were shipped for smelting, copper precipitates from Butte mine waters were shipped to the Anaconda smelter, and zinc slag was treated at a fuming plant.

Gross metal content of Montana crude ore shipped to smelters in 1935, by classes of ore

Class of ore	Quantity (dry weight)	Gross metal content			
		Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry and siliceous	100,071	44,520.50	1,277,633	233,839	374,991
Copper	20,607	169.24	91,044	2,419,107	
Lead	2,549	1,045.05	39,907	17,951	1,027,916
Copper-lead	58	3.46	466	3,110	10,277
	123,285	45,738.25	1,409,050	2,674,007	1,413,184
Total, 1934	51,688	27,900.69	543,027	213,763	2,707,319

Mine production of metals from Montana crude ore shipped to smelters in 1935, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Beaverhead	24,273	6,021.39	250,854	61,092	104,211
Broadwater	6,863	3,688.21	32,660	5,474	175,699
Cascade	229	9.95	7,191	780	10,844
Deer Lodge	2,880	2,040.81	7,520	13,477	7,975
Fergus	893	130.81	14,140	241	1,250
Flathead	18,279	2.00	537,888		
Granite	10,565	4,733.50	87,244	18,458	5,779
Jefferson	7,867	3,654.71	54,587	22,038	123,625
Judith Basin	59	1.40	1,134	241	44,875
Lewis and Clark	5,831	3,442.48	20,479	1,635	101,481
Madison	11,523	12,821.51	61,343	15,374	91,314
Meagher	38	30.50	14	36	
Mineral	2	.20	18		450
Missoula	1,208	338.38	8,277	51,265	9,825
Park	4	3.44	14		
Phillips	1,161	4,137.80	11,571	518	
Powell	4,642	3,104.08	119,551	32,299	156,546
Ravalli	2,508	623.28	10,887	73,289	625
Sanders	453	14.37	2,168	17,189	517,505
Silver Bow	24,007	939.43	181,510	2,292,092	1,025
	123,285	45,738.25	1,409,050	2,605,498	1,353,029
Total, 1934	51,688	27,900.69	543,027	188,462	2,593,433

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead
Dry and siliceous	100,071	44,520.50	1,277,633	223,596	358,080
Copper	20,607	169.24	91,044	2,366,441	
Lead	2,549	1,045.05	39,907	12,969	985,124
Copper-lead	58	3.46	466	2,492	9,825

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Montana in 1935, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Beaverhead County:													
Argenta	17		14,014	5,162.54		5,162.54	30,254		30,254	2,048	52,225		$204,693
Bald Mountain	2		209	63.06		63.06	167		167	1,964	4,500		2,670
Bannack	7	13	18,091	4,915.83	50.17	4,966.00	5,472	7	5,479	2,807	200		177,989
Big Hole		5			20.17	20.17							706
Blacktail	1		183	2.00		2.00	2,098		2,098				1,578
Blue Wing	6		578	14.54		14.54	13,230		13,230	723	2,275	2,614	10,284
Bryant	5		1,660	101.54		101.54	29,753		29,753	7,349	63,200		28,077
Chinatown		2			6.26	6.26							219
Dell	1		40	4.00		4.00	7		7	2,976			392
Elkhorn	1		94	3.00		3.00	1,419		1,419	2,723			1,351
Horse Prairie		2			3.97	3.97							139
Lakeview		1			.43	.43							15
Polaris	3		85	19.43		19.43	1,056		1,056	747	4,450		1,679
Vipond	5		6,959	78.26		78.26	172,242		172,242	40,217			129,876
Wise River	1		15	5.00		5.00	7		7				180
Broadwater County:													
Backer	9	26	408	458.46	109.34	567.80	562	14	576	60	3,275		20,423
Beaver	12		17,214	3,726.94		3,726.94	28,583		28,583	1,795	105,650	14,068	155,981
Cedar Plains	27	3	13,893	2,413.20	14.00	2,427.20	10,631		10,631	4,711	13,100		93,508
Clasoil	1		10	4.20		4.20	7		7		350		166
Park	20	5	938	753.20	20.83	774.03	4,505	4	4,509	1,398	70,625		33,273
Carbon County: Clark Fork of Yellowstone River		4			6.77	6.77							237
Cascade County: Montana	18		3,614	30.80		30.80	29,632		29,632	2,398	63,625	3,773	25,286
Deer Lodge County:													
Dry Gulch		2			7.57	7.57							265
French Gulch		5			9.66	9.66							338
Georgetown	15	1	15,066	2,840.54	15.74	2,856.28	2,720		2,720	12,819	150		102,995
Heber (Mill Creek)	1	5	196	51.20	12.83	64.03	825		825	410	7,625		3,173
Oro Fino	8		158	83.46		83.46	3,854		3,854	265	200		5,721
Silver Lake	1		12				153		153	96			118
Fergus County:													
Cone Butte	2		103	64.34		64.34	825		825				2,845
North Moccasin	2	3	49	6.66	35.40	42.06	462	7	469				1,809
Warm Springs	11	3	1,457	160.60	19.37	179.97	13,223	4	13,227	241	1,250		15,876
Flathead County:													
Hog Heaven	1		18,227				536,665		536,665				385,728

Whitefish	1		52	2.00		2.00	1,223		1,223				949
Gallatin County: West Fork of Gallatin River		1			2.20	2.20							77
Granite County:													
Alps	4	1	693	184.20	2.37	186.57	57		57				6,571
Antelope	1		996	424.00		424.00	302		302	2,410			15,257
Big Springs		1			1.46	1.46							51
Boulder	8	3	418	343.00	17.20	360.20	1,294	7	1,301	1,614	2,050		13,758
Dunkleberg	5		160	6.54		6.54	2,571		2,571	24	3,575		2,222
First Chance	26	28	5,057	3,390.46	189.23	3,579.69	5,991	25	6,016	904	200		129,696
Flint Creek	9		78,850	2,489.00		2,489.00	984,672		984,672	346,518	1,975,100	9,492,250	1,320,272
Frog Pond Basin	1		278	206.00		206.00	914		914				7,867
Gold Creek	2	3	4	6.63	23.37	30.00	7	7	14		75		1,063
Henderson	2		15,477	144.00		144.00	71,015		71,015	86,349			63,249
Medicine Lake	1		91	17.00		17.00	1,184		1,184				1,446
Moose Lake	2		1,722	286.37		286.37	512		512	2,000			10,557
Racetrack Lake	1		5	10.80		10.80							378
Red Lion	4		16,468	2,504.00		2,504.00	146		146	880			87,818
Rock Creek	2	3	71	62.00	24.17	86.17	71	7	78				3,072
Welcome Gulch		1			1.86	1.86							65
Jefferson County:													
Amazon	4		272	36.34		36.34	3,520		3,520	8,434	5,275		4,713
Bigfoot	1	1	9	4.00	.14	4.14	57		57				186
Boulder	4	1	60	11.60	2.17	13.77	576		576	1,084	5,900		1,222
Cataract	17	5	76,086	4,546.23	76.63	4,622.86	367,022	28	367,050	224,024	2,454,100	2,058,636	632,955
Colorado	9		3,300	392.80		392.80	22,233		22,233	6,627	208,625	92,500	42,693
Elkhorn	6		6,042	268.63		268.63	19,456		19,456	807	14,525		24,034
Elk Park	1		28	11.60		11.60	480		480	398	9,075		1,147
Emery	1		1	.20		.20	39		39				35
Homestake	1	1	12	20.23	3.66	23.89							836
Little Pipestone Creek	3		136	53.00		53.00	658		658	1,711			2,470
Lowland	2	1	7	18.00	1.97	19.97	64		64				745
Lump Gulch		3			26.63	26.63		11	11				940
McClellan Creek	4		338	188.60		188.60	174		174	24	525		6,749
Mitchell	2	1	144	130.37	65.86	196.23	249	14	263	24			7,059
Montana City	2	14	12	2.77	2,547.54	2,550.31	192	590	782	434			89,859
Pipestone	9	3	220	79.83	4.83	84.66	1,422	4	1,426	277	1,475		4,070
Warm Springs Creek	5		18,179	1,867.97		1,867.97	6,994		6,994	3,277	65,950		73,316
Whitehall	16	1	4,242	2,242.43	2.60	2,245.03	5,614		5,614	1,024	4,300		82,868
Woodland Park	1		9	13.40		13.40	18		18		50		484
Judith Basin County:													
Barker	3		59	1.40		1.40	1,134		1,134	241	44,875		2,679
Yogo		2			7.97	7.97							279
Lewis and Clark County:													
Bald Butte	4		1,114	193.60		193.60	1,166		1,166	1,036	2,500		7,800
Bear Gulch	1		5	6.20		6.20	11		11				225
Dry Gulch	2	7	36,403	6,017.83	23.34	6,041.17	3,264	4	3,268				213,790
Greenhorn		2			19.03	19 03		7	7				671
Heddleston	1		63	10.74		10.74	352		352	72	11,550		1,097
Helena	10	44	77,362	8,280.23	2,555.06	10,835.29	1,607	238	1,845	2,386	5,000		380,959
Jefferson Gulch	2		67	48.94		48.94	46		46		100		1,750
Lincoln	1	8	2	2.20	75.17	77.37		11	11				2,716

Mine production of gold, silver, copper, lead, and zinc in Montana in 1935, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Lewis and Clark County—Continued.			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Magpie and Cave Gulches		4			69.46	69.46		7	7				$2,436
Missouri River		7			156.63	156.63		14	14				5,492
Ottawa	16	1	4,207	2,362.46	10.26	2,372.72	12,622	7	12,629	434	23,800		93,110
Poorman Creek	1		145	55.40		55.40	82		82				1,998
Priests Pass		1			.40	.40							14
Scratch Gravel	5		461	556.34		556.34	1,099		1,099	120	1,075		20,315
Smelter	1		123,441				13,127		13,127		2,478,550	22,156,886	1,083,480
Stemple	9	2	32,146	9,971.46	2.77	9,974.23	45,650		45,650		1,650		381,975
Vaughn	10	2	838	99.60	19.14	118.74	9,671	14	9,685	2,518	108,700	36,273	17,270
Wolf Creek		1			.20	.20							7
Lincoln County:													
Libby	4	5	299	72.20	50.54	122.74	14	7	21				4,311
Sylvanite	2		5,540	1,233.26		1,233.26	10,251		10,251	4,530	106,875		55,183
Troy	1		1,400	1.34		1.34	1,344		1,344	1,470	108,125	182,182	13,476
Wolf Creek		1			5.80	5.80							203
Yaak River		1			1.26	1.26							44
Madison County:													
Bone Basin	4		237	149.23		149.23	530		530	36			5,607
Cedar Hollow	1		(1)	(1)		(1)	(1)		(1)				(1)
London Mountains		1			.20	.20							7
Lower Hot Springs	15		1,696	2,915.97		2,915.97	2,190		2,190	1,145	30,450		104.946
McCarthy Mountain	4		274	164.26		164.26	651		651	518	17,825		6,973
Mineral Hill	17		29,809	6,635.14		6,635.14	9,383		9,383	36,458			242,000
Norwegian	10		129	172.14		172.14	206		206	687	675		6,257
Rabbit	18	2	393	177.00	6.34	183.34	1,760		1,760	132	35,275		9,104
Ramshorn	5	15	617	215.26	137.17	352.43	192	21	213		150		12,494
Red Mountain		1			10.06	10.06							352
Ruby Creek	1		(1)	(1)		(1)	(1)		(1)				(1)
Ruby Mountains	1		5	2.00		2.00	32		32				93
Sand Creek	2		12	8.20		8.20	32		32				310
Sheridan	12	2	852	967.20	4.23	971.43	4,608		4,608	843			37,382
Silver Star	10	1	1,104	2,248.97	.80	2,249.77	4,256		4,256	9,506	475		82,609
Tidal Wave	26	1	4,839	1,780.66	1.40	1,782.06	4,395		4,395	2,880	21,350		66,624
Upper Hot Springs	12		1,076	755.97		755.97	992		992	530			27,216
Virginia City (Alder Gulch, Summit, etc.)	24	6	18,736	3,453.66	4,618.80	8,072.46	24,576	818	25,394	2,602	15,300		301,616
Washington	8		217	496.14		496 14	1,145		1,145	24	1,600		18.254
West Fork of Madison River		2			4.63	4 63							162
Willow Creek	1	6	2	1.00	12 37	13.37							468

Meagher County:													
Beaver Creek		2			34.94	34.94		7	7				1,228
Camas Creek		3			12.43	12.43		4	4				438
Elk Creek		1			1.77	1.77							62
Little Belt	1		58	32.60		32.60	25		25	36			1,162
Tenderfoot Creek (Smith River)		1			3.23	3.23							113
Thompson Gulch		3			21.60	21.60		7	7				761
Mineral County:													
Cedar Creek		34			330.00	330.00		14	14				11,560
Iron Mountain	1		1				78		78		1,200		104
St. Regis	1		2	.20		.20	18		18		450		38
Missoula County:													
Coloma	6	12	553	362.94	101.40	464.34	110	7	117	60			16,341
Nine Mile		12			372.37	372.37		11	11				13,041
Wallace	1		955	51.46		51.46	8,178		8,178	51,205	9,825		12,322
Park County:													
Crevasse	2		1,746	201.43		201.43	231		231				7,216
Emigrant Creek		12			757.77	757.77		128	128				26,614
New World	4		4,748	692.57		692.57	537		537	1,410	300		24,755
Sheepeater	1	1	38,777	6,073.40	2.60	6,076.00	1,095		1,095	470			213,486
Yellowstone River		7			71.63	71.63		11	11				2,515
Phillips County: Little Rockies	5	4	33,826	11,564.20	20.03	11,584.23	20,736	7	20,743	518			420,400
Powell County:													
Big Blackfoot	1	6	17	21.77	130.86	152.63	50	21	71				5,393
Blossburg	1		8	1.83		1.83							64
Champion		1			.54	.54							19
Douglas Creek		2			10.54	10.54		4	4				372
Nigger Hill	7	1	1,905	711.74	2.23	713.97	16,992		16,992	30,193	14,525		40,289
Ophir		1			1,765.14	1,765.14		185	185				61,913
Pioneer	2	23	20	75.26	9,444.03	9,519.29	64	988	1,052	84			333,938
Racetrack Creek	2	1	3	2.26	.63	2.89							101
Top O' Deep	1		14	11.00		11.00	7		7				390
Washington Gulch	3	10	48	33.57	1,425.63	1,459.20	7	139	146		50		51,179
Zozell	8		14,373	3,473.17		3,473.17	129,586		129,586	2,169	144,500		220,661
Ravalli County:													
Curlew	1		2,494	615.00		615.00	10,887		10,887	73,289	625		35,458
Eight Mile	1		13	8.00		8.00							280
Overwich	3	4	62	32.20	247.06	279.26		14	14				9,784
Stevensville		1			1.14	1.14							40
Sanders County:													
Eagle	1		11,153	22.03		22.03	9,440		9,440	12,024	2,241,675	230,068	108,344
Revais Creek	1		76	11.17		11.17	103		103	14,265			1,649
Vermillion		2			73.23	73.23		14	14				2,573
Silver Bow County:													
Butte or Summit Valley	31		1,608,409	7,835.80		7,835.80	6,522,873		6,522,873	153,928,470	20,603,950	75,292,227	21,875,647
Divide Creek	8		52	21.00		21.00	537		537	48			1,125
Flint Creek	1		903	128.00		128.00	22,645		22,645				20,756

[1] Included under "Undistributed."

Mine production of gold, silver, copper, lead, and zinc in Montana in 1935, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Silver Bow County—Con.													
German Gulch	1	8	2	.20	95.80	96.00	32	7	39		1,025		$3,429
Highland	3	3	2,011	695.94	52.57	748.51	82	7	89	470			26,301
Independent	3	1	24	2.00	1.77	3.77	373		373				400
Lost Child	1	1	4	1.66	5.03	6.69	11		11				242
Melrose	1		43	6.00		6.00	1,184		1,184				1,061
Silver Bow Creek		117			193.83	193.83		43	43				6,815
Undistributed [2]			3,551	2,117.60		2,117.60	30,108		30,108				95,756
Total Montana, 1935	681	551	2,412,113	124,788.80	26,299.23	151,088.03	9,319,456	3,495	9,322,951	154,957,470	31,177,525	109,561,477	30,918,228
1934	583	654	1,066,952	71,902.06	25,543.89	97,445.95	4,003,331	3,137	4,006,468	63,265,000	20,010,000	61,442,256	14,439,363

[1] Included under "Undistributed."

[2] Includes items entered as "([1])" above.

In the following review by counties and mining districts, only the more important operations are mentioned. Many small producing mines and several districts and counties whose output is included in the foregoing tables are omitted from this review.

BEAVERHEAD COUNTY

The Ermont mine near Argenta was operated the last 6 months of of 1935, and about 4,300 tons of gold ore were shipped to Anaconda for smelting; operations continued in 1936, and the company built a new 100-ton cyanidation plant, which was placed in operation in November 1936. The Shafer mine (Argenta district) was operated in 1935 by the Steele lease, and about 5,800 tons of gold ore were shipped for smelting; in 1936, the Shafer property, together with the Ground Hog and several other mines in the district, was acquired under lease by the Argenta Consolidated Goldfields, Inc., and a new cyanidation plant was under construction in 1936. The Thompson Gold Milling Co. continued operations at the Sleeping Princess mine at Bannack in 1935 and treated nearly 14,000 tons of ore by cyanidation (the company also shipped ore from the adjoining Gold Bug mine for smelting); the Sleeping Princess mine and mill were idle during 1936. The Quartz Hill Mining Co. shipped about 6,900 tons of silver ore of smelting grade from the Lone Pine & Argyle Silver and Aurora properties in the Vipond district in 1935; operations continued in 1936, and production increased to nearly 8,800 tons.

BROADWATER COUNTY

The Vosburg Mining Co. completed a new 50-ton cyanidation plant at the Vosburg group in the Beaver district, and in 1935 milled more than 14,000 tons of gold ore; operations continued in 1936, but the output of gold was only half that in 1935. The Keating property near Radersburg was acquired in 1935 by the C-G Gold Corporation. A new 100-ton flotation mill was completed and placed in operation in September 1935, and several thousand tons of dump ore were milled; milling operations on dump ore continued in 1936, and the production of gold (in flotation concentrates) was nearly three times that in 1935.

DEER LODGE COUNTY

A group of claims, including the Holdfast, Short Shift, and Oro Fino, in the Georgetown district, was acquired in 1935 by Thomas H. Sheridan, and a new cyanidation plant was under construction at the property at the end of the year; but the only production in 1935 was lessees' ore shipped for smelting. In 1936 the new mill was placed in operation, the output of gold increased markedly, and the mine became the most important producer in Deer Lodge County. The Gold Coin Mines Co. operated the Gold Coin mine and mill in 1935 and treated more than 12,000 tons of gold ore by amalgamation and concentration; commercial ore reserves were exhausted, however, and in 1936 the company was re-treating old tailings by cyanidation. Lessees continued shipping gold ore of smelting grade from the Southern Cross mine at about the same rate in both 1935 and 1936.

FERGUS COUNTY

There were no important producers in Fergus County in 1935, but in 1936 the North Moccasin Mines Syndicate was organized to acquire the old Barnes-King property 20 miles north of Lewistown. A 50-ton cyanide plant was built and placed in operation in August 1936, and several thousand tons of gold ore were milled by the end of the year.

FLATHEAD COUNTY

The Anaconda Copper Mining Co. continued shipments of silver ore from the Flathead mine near Kila in both 1935 and 1936. More than 18,000 tons of ore were shipped to the smelter at Anaconda in 1935, but the 1936 output decreased about 10 percent.

GRANITE COUNTY

The Trout Mining Co. continued regular operations at the Trout & Algonquin property at Philipsburg in 1935 and 1936 (the company abandoned its incorporated status in 1936, and operations continued as the Trout Mining Division of American Machine & Metals, Inc.). The company completed the construction of a 50-ton flotation plant at Philipsburg in 1935 and treated about 7,300 tons of partly oxidized silver-lead-zinc ore in the new mill before the end of the year (the new mill treated about 23,000 tons of ore in 1936); in addition, regular shipments of ore to the zinc-flotation plant at Anaconda continued in both 1935 and 1936. The total output of all classes of ore in 1935 was about 46,000 tons; in 1936 the output increased to about 64,000 tons. The Philipsburg Mining Co. built a new 160-ton flotation plant (replacing the mill destroyed by fire in 1934) at the Granite Bimetallic mine in 1935 and milled about 25,000 tons of silver ore before the end of the year; the output was more than doubled in 1936. The Silver Prince Mining Co. was reorganized as the Contact Mines Corporation in May 1936; regular shipments of lead-zinc ore to the mill at Anaconda were continued in both 1935 and 1936. Lessees acquired the Two Per Cent mine near Philipsburg late in 1935 and in 1936 shipped more than 9,000 tons of siliceous silver ore to Anaconda for smelting. The Lakes Mining & Milling Syndicate was reorganized as the Hidden Lake Venture, Inc., in September 1936; in 1935 the company treated about 16,000 tons of ore in the 75-ton cyanidation plant, and in 1936 the output of gold increased more than 50 percent.

JEFFERSON COUNTY

The Basin Montana Tunnel Co. continued operations at the Comet & Gray Eagle property at a normal rate in both 1935 and 1936. In 1935 nearly 59,000 tons of lead-zinc ore were treated in the 200-ton flotation mill, and in 1936 about 62,300 tons were milled. The output of gold and silver increased in 1936, and the company was by far the most important producer in Jefferson County. The Basin Gold Mines, Inc., treated more than 14,000 tons of dump ore from the Jib mine in the 300-ton flotation mill in 1935; in 1936 the mill was not operated, but about 2,800 tons of siliceous ore were shipped for smelting. The United Gold Mines Corporation acquired the Mount Washington mine (Colorado district) in 1935 and began construction of a 150-ton flotation mill; a little lead-zinc ore was shipped to the Comet mill in

1935, and in January 1936 the new mill was placed in operation and more than 14,000 tons were treated. The Winston Bros. Co. continued operations at the placer property on Prickly Pear Creek north of Clancy in both 1935 and 1936 at a normal rate (the 1936 output was slightly greater than that in 1935). The floating washer and dragline excavator were dismantled late in 1936 and moved 500 feet to a new location; operations were resumed early in 1937.

LEWIS AND CLARK COUNTY

The Golden Messenger mine in the Dry Gulch district was operated continuously in 1935 and 1936; about 36,400 tons of gold ore were treated in the 125-ton cyanidation plant in 1935, and the output increased to about 44,300 tons in 1936. The Montana Consolidated Mines Corporation resumed production at the Spring Hill mine on March 16, 1935 (after a mine strike had been settled), and operated continuously for the remainder of 1935 and all of 1936; in 1935 about 76,800 tons of ore were treated in the 300-ton flotation plant, and in 1936 more than 93,200 tons were milled. The Porter Bros. Corporation completed the erection of a 4,500-cubic-yard electric dredge at the Last Chance Gulch property near Helena in November 1935 and operated continuously from November 3, 1935, to the end of the year and all of 1936 except a short time in February. About 282,000 cubic yards of gravel were dredged in 1935, and in 1936 the dredge handled nearly 1,769,000 cubic yards; the company was the largest producer of gold in Montana in 1936. The Anaconda Copper Mining Co. operated the slag-fuming plant at East Helena on current lead-smelter slag continuously in both 1935 and 1936; the 1936 output of zinc fume was considerably less than that in 1935. At the Gould mine near Wilborn the Standard Silver-Lead Mining Co. produced 26,389 tons of ore in 1935 and 27,691 tons in 1936; the ore was treated in an 80-ton cyanidation plant.

LINCOLN COUNTY

Most of the production from Lincoln County in 1935 was gold ore from the Keystone mine (Sylvanite district) treated by amalgamation and flotation and lead-zinc ore from the Giant Sunrise property (Troy district) treated by concentration.

MADISON COUNTY

In 1935 the Liberty Montana Mines Co. treated 13,530 tons of ore from the Mammoth & Leviathan mine in the 150-ton flotation mill; the output increased to 19,662 tons in 1936. The Pacific Gold Mining Co. milled nearly 15,000 tons of ore from the Boss Tweed & Clipper mine in 1935, and the output was about the same in 1936. The Boaz mine was the most important producer in the Norris area in 1935; the mine was operated by the Jack Pot Mining Co., and nearly 2,300 ounces of gold were produced in ore of smelting grade. The Mayflower mine near Renova was reopened in July 1935 by the West Mayflower Mining Co. (Anaconda Copper Mining Co.), and about 2,200 tons of gold ore were shipped for smelting; in 1936 the company increased the output to more than 7,400 tons. The Golden Rod Mining Co. continued operations at the Golden Rod mine in the Silver Star district in 1935 and 1936, but the 1936 output was considerably less than that in 1935. The Humphreys Gold Corporation completed the erection

of a 5,000-cubic-yard dry-land dredge at its Alder Gulch property in June 1935, and from July 1 to December 31 the company handled 412,121 cubic yards of gravel in the new plant. The dredge was the most important producer in the Virginia City region in 1935, and in 1936 the company became the second largest producer of gold in Montana. Most of the lode-mine production at Virginia City in 1935 came from the Prospect and Marietta mines; there was a decrease in lode production in the district in 1936.

PARK COUNTY

In 1935 the Jardine Mining Co. treated nearly 39,000 tons of ore by amalgamation and concentration and produced more than 6,000 ounces of gold; in 1936 nearly 41,000 tons of ore were milled, but the gold output decreased sharply. The McLaren Gold Mines Co. operated the New Years Gift mine for 4 months in 1936; nearly 4,300 tons of ore were treated in the rebuilt amalgamation and concentration mill, and more than 1,200 ounces of gold were produced, a marked increase from the 1935 output.

PHILLIPS COUNTY

The Little Ben Mining Co. operated continuously at the August mine in 1935 and 1936; nearly 33,000 tons of ore were treated in the 100-ton cyanidation plant in 1935, and about 43,000 tons were milled in 1936. The Ruby Gulch Mining Co. shipped about 1,100 tons of rich gold ore to a smelter in 1935 and started construction of a cyanide plant; the new mill was completed and placed in operation in 1936 and the output of gold was nearly twice that produced in 1935.

POWELL COUNTY

The Pioneer Placer Dredging Co. continued operations at the 6,000-cubic yard electric dredge on Gold Creek, Pioneer district, at a normal rate in both 1935 and 1936; about 1,945,400 cubic yards were dredged in 1935, and in 1936 the dredge handled about 1,576,500 cubic yards of gravel. The dredge ranked first in placer production in Montana in 1935 but dropped to third place in 1936. The dredge of Yuba Consolidated Goldfields, in Ophir Gulch, which started operations in January 1934, ran until July 1935, when it was dismantled and moved to a placer in California. Most of the remainder of the placer output from Powell County in 1935 came from the Fontana placer of the El Dorado Gold Placer Mining Co. in Washington Gulch; the company operated the dragline and portable washing plant from April to November in both 1935 and 1936. Most of the lode-mine output from Powell County in 1935 was siliceous ore from the Emery mine in the Zozell or Emery district, which was operated by Tweedy Bros. Corporation, a lessee, and nearly 12,000 tons of gold and silver ore were treated in the rebuilt flotation plant; however, the lessee gave up the property in March 1936, and the 1936 production decreased sharply.

SANDERS COUNTY

The American Smelting & Refining Co. continued regular operations at the Jack Waite property in the Eagle district in both 1935 and 1936. The property extends over the State line into Shoshone

County, Idaho, and part of the 1936 output came from the Idaho side. In 1936 the output (from Montana) consisted of 37,000 tons of lead-zinc ore of milling grade and 1,084 tons of lead ore of smelting grade, a marked increase from 10,776 tons of lead-zinc ore and 377 tons of lead ore produced in 1935. The milling ore is treated in the 500-ton flotation plant at Duthie, Idaho.

SILVER BOW COUNTY

The following table gives the output from mines in Silver Bow County in 1934 and 1935; final data for 1936 are not available, but substantial increases were recorded in the output of all metals except zinc.

Production of gold, silver, copper, lead, and zinc in Silver Bow County, Mont., 1934–35, in terms of recovered metals

Year	Mines producing	Ore	Gold (lode and placer)	Silver (lode and placer)	Copper	Lead	Zinc	Total value
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1934	175	644, 487	3, 861. 03	2, 826, 252	62, 856, 150	10, 781, 757	42, 329, 372	$9, 209, 595
1935	179	1, 611, 448	9, 039. 60	6, 547, 794	153, 928, 988	20, 604, 975	75, 292, 227	21, 935, 776

From 1882 (the first year for which detailed records are available) to the end of 1935 the mines in Silver Bow County, which includes the Butte or Summit Valley district, produced the five metals, as follows: Gold, 1,825,331.77 fine ounces; silver, 473,822,856 fine ounces; lead, 354,048,798 pounds; copper, 10,653,603,191 pounds; and zinc, 2,715,980,453 pounds. The total value of this production is $2,210,496,035.

Butte or Summit Valley district.—In 1935, the Anaconda Copper Mining Co. produced 1,239,285 tons of copper ore of milling grade and 19,484 tons of copper ore of smelting grade (compared with 456,909 tons of mill ore and 304 tons of smelting ore in 1934); in 1936 the output of milling ore increased to 1,840,738 tons and smelting ore to 24,100 tons (in addition, in 1936 the company re-treated 545,530 tons of old copper tailings by combined acid-leaching and flotation and smelted 18,125 tons of pond slimes). These increases resulted in a gradual gain in the output of blister copper at the smelter, and the copper plant was operating at near capacity at the end of 1936. The output of lead-zinc ore from the Orphan Girl and Emma mines increased 156,106 tons compared with 1934, and the 1936 output was about the same as that in 1935; there was a decrease, however, of about 10 percent in the production of net zinc in 1936 compared with 1935.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEVADA

(MINE REPORT)[1]

By Charles White Merrill and H. M. Gaylord [2]

SUMMARY OUTLINE

The output of gold, silver, copper, lead, and zinc from Nevada ores, gravel, and re-treated tailings in 1936, in terms of recovered metals, was 284,700 fine ounces of gold valued at $9,964,500; 4,970,000 fine ounces of silver valued at $3,849,265; 135,650,000 pounds of copper valued at $12,479,800; 24,610,000 pounds of lead valued at $1,132,060; and 31,570,000 pounds of zinc valued at $1,578,500—a total of $29,004,125. In 1935 Nevada mines yielded 188,031 ounces of gold valued at $6,581,085; 4,393,426 ounces of silver valued at $3,157,775; 74,266,000 pounds of copper valued at $6,164,078; 25,352,000 pounds of lead valued at $1,014,080; and 31,072,000 pounds of zinc valued at $1,367,168—a total of $18,284,186. For each metal the value of the output increased substantially. Gold increased 51 percent in both quantity and value, silver 13 percent in quantity and 22 percent in value, copper 83 percent in quantity and 102 percent in value, and zinc 2 percent in quantity and 15 percent in value; lead decreased 3 percent in quantity but increased 12 percent in value. The total calculated value of the metal output in 1936 exceeded that in 1935 by $10,719,939 (59 percent) and was the largest in any year since 1929. The value of gold production exceeded that in any year since 1915, although the quantity produced in 1936 was exceeded as late as 1918. Of the total value of the five metals in 1936, gold contributed 35 percent, silver 13 percent, copper 43 percent, lead 4 percent, and zinc 5 percent. During 1936 White Pine County was the largest contributor to the nonferrous mineral wealth of the State, and the rising price of copper during 1936 was a favorable factor in continuing the expansion of metal production in this area. The high price for gold and silver stimulated mining in such districts as Tonopah, Manhattan, and

[1] Figures for 1936 are preliminary; detailed data with final revisions will be released later.

[2] The assistance of L. F. Janssen is acknowledged.

Round Mountain in Nye County and the Comstock Lode in Storey and Lyon Counties. The Pioche district again led in zinc and lead production. Lessees were very active in many of the camps in the State, and several new producing companies were added to the list of organizations already on a productive basis.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the prices given in the table that follows. Gold in 1932 is figured at \$20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1837, to January 31, 1934; in 1933 at \$25.56 and in 1934 at \$34.95 per ounce, the yearly average weighted United States Government price [1]; and in 1935 and 1936 at \$35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1932 and 1933 is the average New York price for bar silver; in 1934, the Treasury buying price (\$0.64646464 per ounce) for newly mined silver; and in 1935 and 1936, the yearly average weighted Treasury buying price for newly mined silver. The copper, lead, and zinc prices are weighted yearly averages of all grades of primary metal sold by producers.

Prices of gold, silver, copper, lead, and zinc, 1932–36

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[1] \$20.67+	\$0.282	\$0.063	\$0.030	\$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050

[1] \$20.671835.

[2] \$0.64646464.

Mine production of gold, silver, copper, lead, and zinc in Nevada, 1932–36, in terms of recovered metals

Year	Mines producing		Ore, old tailings, etc. (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1932	382	103	1,855,031	129,719.83	\$2,681,547	1,304,365	\$367,831
1933	422	116	1,678,454	98,590.28	2,519,968	1,148,621	402,017
1934	635	160	2,899,782	144,275.17	5,042,417	3,057,114	1,976,316
1935	706	149	4,392,819	188,031.00	6,581,085	4,393,426	3,157,775
1936 [1]	[2]	[2]	[2]	284,700.00	9,964,500	4,970,000	3,849,265

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1932	31,487,606	\$1,983,719		\$26,430	254,795	\$7,644	\$5,067,171
	28,489,610	1,823,335	4,606,732	170,449	12,774,550	536,531	5,452,300
1934	41,611,119	3,328,890	21,981,874	813,329	27,880,790	1,198,874	12,359,826
1935	74,266,000	6,164,078	25,352,000	1,014,080	31,072,000	1,367,168	18,284,186
1936 [1]	135,650,000	12,479,800	24,610,000	1,132,060	31,570,000	1,578,500	29,004,125

[1] Subject to revision.

[2] Figures not yet available.

[1] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at \$35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Gold and silver produced at placer mines in Nevada, 1931–35 [1]

Year	Gold		Silver	
	Fine ounces	Value	Fine ounces	Value
1931	2,883.25	$59,602	860	$249
1932	5,408.22	111,798	1,743	492
1933	5,769.54	147,470	1,991	697
1934	5,248.91	183,449	1,594	1,030
1935	7,880.00	275,800	2,609	1,875

[1] Figures for 1936 not yet available.

Gold.—The mine production of recoverable gold in Nevada in 1936 was close to 284,700 fine ounces valued at $9,964,500, an increase of 51 percent in both quantity and value over 1935. Exact figures are not available on proportionate contribution of lode and placer mines, but the data at hand indicate that almost all the gold was derived from lode properties as in 1935, when only 4 percent came from placer operations. In 1935, 74 percent of the lode gold produced in Nevada came from dry gold ore, but reviving activity at the base-metal mines, notably in the Robinson district in White Pine County, probably decreased the proportion from this type of ore in 1936. The higher price of silver was an important factor in the production of gold as the two metals so commonly accompany each other in the ores of the State. The four largest gold properties, listed approximately in order of their importance as producers, were as follows: Nevada Consolidated Copper Corporation (White Pine County), Goldfield Consolidated Mines Co. (Esmeralda County), Black Mammoth Consolidated Mining Co. (Esmeralda County), and Nevada Porphyry Gold Mines, Inc. (Nye County). In addition, there were many small producers of gold in the State.

Silver.—Recoverable silver produced in Nevada is closely calculated at 4,970,000 fine ounces valued at $3,849,265 in 1936, compared with 4,393,426 ounces valued at $3,157,775 in 1935. This represents an increase of 13 percent in quantity and 22 percent in value over 1935. The higher price of silver established by the United States Treasury in 1935 continued to stimulate mining in the State. Nye County was the leading producer of silver, followed in order by Lincoln, White Pine, and Storey Counties; the order was the same also in 1935 and 1934. Preliminary figures for 1936 indicate that Nye County continued as the leading silver producer by a wide margin, but reviving copper mining in White Pine County where silver is a byproduct and precious-metal mining in Esmeralda County seemed likely to have upset the order in which the other counties had stood. A few of the major silver producers derived their silver from straight argentiferous ores, but most of the silver output of Nevada came as a byproduct of gold, copper, lead, and zinc mining. The companies with the largest output of silver, listed approximately in the order of their importance, were as follows: Treadwell Yukon Co., Ltd. (Nye County), The Tonopah Mining Co. of Nevada (Nye County), Combined Metals Reduction Co. (Lincoln County), Nevada Consolidated Copper Corporation (White Pine County), General Metals Recovery Corporation (Esmeralda County), and Arizona Comstock Corporation (Storey County). The remainder of the silver output of Nevada came from a large number of small properties.

Copper.—The mine output of recoverable copper in Nevada is closely calculated as 135,650,000 pounds valued at $12,479,800 in 1936. This increase of 83 percent in quantity and 102 percent in value over 1935 returned copper to first place, with respect to value, among the metals produced in Nevada; gold had enjoyed this distinction since 1931. The Nevada Consolidated Copper Corporation in White Pine County produced far more copper than all other mines in the State together, but a substantial and increasing output was reported in Elko County by the Mountain City Copper Co., which is affiliated with the Anaconda Copper Mining Co.

Lead.—The mine production of recoverable lead in Nevada is closely calculated at 24,610,000 pounds valued at $1,132,060 in 1936, compared with 25,352,000 pounds valued at $1,014,080 in 1935; this is a decrease of 3 percent in quantity but an increase of 12 percent in value. Lincoln and Nye Counties were the leading producers of lead in both 1935 and 1936. Most of the production came from two companies, the Treadwell Yukon Co., Ltd., at Tybo (Nye County) and the Combined Metals Reduction Co. at Pioche (Lincoln County). Small outputs, many of them in the form of shipping ore, were reported from a large number of mines throughout the State. The two leading producers of lead in the State mined lead-zinc ore, and at both properties the precious-metal content of the ore was a very important factor in the revenue obtained.

Zinc.—The mine production of recoverable zinc in Nevada is closely calculated as 31,570,000 pounds valued at $1,578,500 in 1936, compared with 31,072,000 pounds valued at $1,367,168 in 1935, an increase of 2 percent in quantity and 15 percent in value. The bulk of the zinc production, like that of lead, came from the Combined Metals Reduction Co. at Pioche (Lincoln County) and the Treadwell Yukon Co., Ltd., at Tybo (Nye County).

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1935, by counties, in terms of recovered metals

County	Gold					Silver (lode and placer)	
	Lode		Placer		Total value		
	Fine ounces	Value	Fine ounces	Value		Fine ounces	Value
Churchill	1,926.25	$67,419	----------	----------	$67,419	33,348	$23,969
Clark	6,946.74	243,136	16.06	$562	243,698	24,318	17,479
Douglas	27.28	955	3.72	130	1,085	26	19
Elko	1,990.21	69,657	85.97	3,009	72,666	97,156	69,831
Esmeralda	21,955.32	768,436	549.42	19,230	787,666	258,463	185,770
Eureka	3,402.37	119,083	660.57	23,120	142,203	46,251	33,243
Humboldt	6,009.16	210,321	121.74	4,261	214,582	88,996	63,966
Lander	5,174.31	181,101	1,424.58	49,860	230,961	137,062	98,513
Lincoln	9,144.92	320,072	15.36	538	320,610	800,889	575,639
Lyon	17,094.49	598,307	117.72	4,120	602,427	104,650	75,217
Mineral	6,436.63	225,282	205.25	7,184	232,466	39,722	28,550
Nye	30,553.80	1,069,383	3,385.49	118,492	1,187,875	1,661,678	1,194,331
Ormsby	7.64	267	----------	----------	267	30	22
Pershing	6,421.49	224,752	1,023.77	35,832	260,584	87,576	62,945
Storey	17,909.85	626,845	10.46	366	627,211	333,283	239,547
Washoe	534.03	18,691	14.12	494	19,185	4,397	3,160
White Pine	44,283.00	1,549,905	242.56	8,490	1,558,395	674,437	484,752
Undistributed [1]	333.51	11,673	3.21	112	11,785	1,144	822
	180,151.00	6,305,285	7,880.00	275,800	6,581,085	4,393,426	3,157,775
Total, 1934	139,026.26	4,858,968	5,248.91	183,449	5,042,417	3,057,114	1,976,316

[1] No information as to county of origin.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1935, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Churchill	372	$31	7,233	$289			$91,708
Clark	18,108	1,503	231,908	9,276	15,380	$677	272,633
Douglas							1,104
Elko	7,957,968	660,511	1,257,554	50,302			853,310
Esmeralda	8,492	705	44,545	1,782			975,923
Eureka	22,217	1,844	484,662	19,386			196,676
Humboldt	1,440	120	17,486	699			279,367
Lander	114,711	9,521	68,665	2,747			341,742
Lincoln	368,108	30,553	11,787,176	471,487	24,366,053	1,072,106	2,470,395
Lyon	1,339	111	946	38			677,793
Mineral	64,437	5,348	39,945	1,598			267,962
Nye	60,913	5,056	11,171,343	446,854	6,690,567	294,385	3,128,501
Ormsby							289
Pershing	6,918	574	26,380	1,055			325,158
Storey	1,627	135	1,347	54			866,947
Washoe	8,305	689	12,994	520			23,554
White Pine	65,631,045	5,447,377	199,816	7,993			7,498,517
Undistributed [1]							12,607
	74,266,000	6,164,078	25,352,000	1,014,080	31,072,000	1,367,168	18,284,186
Total, 1934	41,611,119	3,328,890	21,981,874	813,329	27,880,790	1,198,874	12,359,826

[1] No information as to county of origin.

Ore, old tailings, etc., sold or treated and lode mines producing in Nevada, 1934–35, by counties

County	Ore, old tailings, etc. (short tons)		Lode mines producing [1]	
	1934	1935	1934	1935
Churchill	2,545	5,378	17	19
Clark	16,391	43,706	40	64
Douglas	182	21	4	5
Elko	9,934	29,296	53	61
Esmeralda	438,948	559,158	42	40
Eureka	4,505	7,297	11	23
Humboldt	6,786	21,892	41	31
Lander	10,725	16,332	55	65
Lincoln	124,033	162,178	28	34
Lyon	35,395	123,365	31	31
Mineral	8,100	15,571	54	73
Nye	188,657	172,995	98	93
Ormsby	31	102	4	1
Pershing	24,648	33,999	47	53
Storey	155,563	225,929	33	34
Washoe	841	850	18	13
White Pine	1,872,498	2,974,210	59	66
Undistributed [2]		540		(1)
	2,899,782	4,392,819	635	706

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] No information as to county of origin.

MINING INDUSTRY

Expansion of copper and gold production was the outstanding feature of the year 1936. Until 1936 the mining industry of the State was helped more by price-raising legislation than by free metal markets. During 1936, however, expanding consumption of copper, lead, and zinc and sharply rising prices toward the close of the year proved to be dominant factors in the return of prosperity to Nevada mineral industries. Continuation of the consumption and price levels estab-

lished during the early months of 1937 would result in the most profitable period that the mineral industry of the State has enjoyed for several years. No State in the Union depends so much on the mining industry for the livelihood of its citizens as does Nevada, and the number of properties being prospected, developed, and equipped is encouraging.

ORE CLASSIFICATION

Ore, old tailings, etc., sold or treated in Nevada in 1935, with content in terms of recovered metals

Source	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold ore	[1] 1,168,951	132,840.90	1,034,686	175,274	185,093	
Dry gold-silver ore	5,336	1,327.88	72,371	2,761	133,543	
Dry silver ore	89,464	10,245.94	1,416,381	40,895	68,362	
Copper ore	2,904,641	30,527.75	121,908	73,682,748	52,319	
Lead ore	29,494	2,144.26	293,567	303,804	4,058,506	
Copper-lead ore	135	5.98	2,134	2,621	29,725	
Lead-zinc ore	194,798	3,058.29	1,449,770	57,897	20,824,452	31,072,000
Total, lode mines	4,392,819	180,151.00	4,390,817	74,266,000	25,352,000	31,072,000
Total, placers		7,880.00	2,609			
	4,392,819	188,031.00	4,393,426	74,266,000	25,352,000	31,072,000
Total, 1934	2,899,782	144,275.17	3,057,114	41,611,119	21,981,874	27,880,790

[1] Includes 606,735 tons of old tailings cyanided, 4,764 tons of old tailings amalgamated, 42,687 tons of old tailings concentrated, and 1,591 tons of old tailings smelted.

Ore, old tailings, etc., sold or treated in Nevada in 1935, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	4,776	1,749.69	2,479	83	40	
Clark	38,477	6,911.81	20,877	13,753	76,717	
Douglas	21	27.28	25			
Elko	9,110	1,922.53	19,172	1,072	2,575	
Esmeralda	[1] 556,647	21,138.25	218,457	7,522	16,999	
Eureka	2,361	1,641.35	8,409	7,732	3,781	
Humboldt	13,657	5,737.66	51,666		3,189	
Lander	12,480	4,913.79	28,219	67,577	14,599	
Lincoln	53,123	6,801.68	30,146	7,804	4,985	
Lyon	123,365	17,094.49	104,614	1,339	946	
Mineral	15,270	6,357.54	23,852	63,096	32,091	
Nye	48,614	21,291.97	26,002	424	9,292	
Ormsby	102	7.64	30			
Pershing	21,061	5,975.69	24,390	3,245	1,713	
Storey	225,929	17,909.85	333,276	1,627	1,347	
Washoe	652	519.03	440			
White Pine	42,766	12,507.14	141,488		16,819	
Undistributed [2]	540	333.51	1,144			
	1,168,951	132,840.90	1,034,686	175,274	185,093	
Total, 1934	809,525	110,128.15	614,960	113,809	120,290	

DRY GOLD-SILVER ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Churchill	67	28.74	2,192			
Elko	201	5.35	232			
Esmeralda	1,955	695.20	29,201			
Eureka	1,160	245.94	10,575	1,165	43,069	
Humboldt	33	41.32	2,628		29	
Lincoln	1,714	289.07	26,600	1,596	90,445	
White Pine	206	22.26	943			
	5,336	1,327.88	72,371	2,761	133,543	
Total, 1934	73,824	7,873.88	623,467	2,159	16,895	

[1] Includes 582,674 tons of old tailings cyanided. [2] No information as to county of origin.

Ore, old tailings, etc., sold or treated in Nevada in 1935, by counties, with content in terms of recovered metals—Continued

DRY SILVER ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	529	147.16	28,466	279	3,179	
Clark	111	4.93	2,209			
Elko	65	12.01	3,102	585	129	
Esmeralda	478	41.21	10,192	230	12,335	
Eureka	265	44.56	9,510	245	2,226	
Humboldt	8,120	210.57	31,611	122	150	
Lander	2,876	159.87	93,889	3,307	21,392	
Lincoln	2,575	42.09	58,527	29,235	14,915	
Mineral	295	78.99	15,379	1,212	6,021	
Nye	17,863	7,701.58	681,315	419	1,140	
Pershing	12,876	404.66	59,593	3,600	4,196	
Washoe	116	11.67	2,523	1,443	981	
White Pine	43,295	1,386.64	420,065	218	1,698	
	89,464	10,245.94	1,416,381	40,895	68,362	
Total, 1934	18,105	985.23	271,217	6,797	88,137	

COPPER ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Clark	53	27.10	71	3,987		
Elko	15,691	.60	698	7,946,595	51,006	
Humboldt	27	3.63	1,340	1,291	612	
Lander	698	82.25	9,028	43,241		
Lincoln	512	60.00	3,246	51,392	701	
Washoe	33	1.31	382	6,766		
White Pine	2,887,627	30,352.86	107,143	65,629,476		
	2,904,641	30,527.75	121,908	73,682,748	52,319	
Total, 1934	1,819,913	16,138.79	74,225	41,015,015	1,250	

LEAD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Churchill	6	0.66	211	10	4,014	
Clark	5,025	2.90	932	368	144,967	
Elko	4,202	49.55	73,725	8,037	1,199,361	
Esmeralda	78	80.66	410	740	15,211	
Eureka	3,511	1,470.52	17,706	13,075	435,586	
Humboldt	55	15.98	1,727	27	13,506	
Lander	278	18.40	5,707	586	32,674	
Lincoln	15,582	305.79	176,730	278,081	1,899,402	
Mineral	6	.10	432	129	1,833	
Nye	432	148.25	8,639	2,173	123,411	
Pershing	62	41.14	3,491	73	20,471	
Washoe	49	2.02	1,047	96	12,013	
White Pine	208	8.29	2,810	409	156,057	
	29,494	2,144.26	293,567	303,804	4,058,506	
Total, 1934	24,931	1,792.96	277,986	429,684	3,906,921	

COPPER-LEAD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Elko	27	0.17	191	1,679	4,483	
White Pine	108	5.81	1,943	942	25,242	
	135	5.98	2,134	2,621	29,725	
Total, 1934	72	13.80	3,398	7,216	21,162	

LEAD-ZINC ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Clark	40		229		10,224	15,380
Lincoln	88,672	1,646.29	505,626		9,776,728	24,366,053
Nye	106,086	1,412.00	943,915	57,897	11,037,500	6,690,567
	194,798	3,058.29	1,449,770	57,897	20,824,452	31,072,000
Total, 1934	153,412	2,093.45	1,190,267	36,439	17,827,219	27,880,790

[1] Includes 532,674 tons of old tailings cyanided.

METALLURGIC INDUSTRY

Data available by May 24, 1937, do not include detailed information on the Nevada metallurgic industry for 1936. Most of the mills operating in 1935 continued to do so in 1936, and substantial additions were made to the State milling capacity during the year; new plants were built and additions or improvements made at old ones. The increased production of copper ore in the Robinson district considerably augmented the output of the only smelter in the State, the copper smelter at McGill. This plant depended chiefly on ores produced by its owner, the Nevada Consolidated Copper Corporation, but it did a substantial custom business on ores purchased largely for fluxing. Custom mills were operated in various parts of the State; important ones were at Silver City, Lyon County; Midas, Elko County; Seven Troughs, Pershing County; and Searchlight and Goodsprings, Clark County. Large quantities of ore were shipped out of the State, principally to the lead and copper smelters in the Great Salt Lake Basin. The Bauer (Utah) plant of the Combined Metals Reduction Co. treated all the company lead-zinc ore mined at Pioche. The 300-ton flotation mill completed by the Mountain City Copper Co. in the Cope district was an important addition to the metallurgic equipment of the State.

Mine production of metals in Nevada in 1935, by methods of recovery

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore, old tailings, etc., amalgamated	174,123	42,188.84	84,906			
Ore, old tailings, etc., cyanided	663,623	28,304.38	346,917	4,664	278	
Concentrates smelted:						
Flotation	175,516	51,340.04	2,069,951	65,625,327	21,029,903	31,056,620
Table	409	3,907.48	5,696	1,783	28,541	
Ore, old tailings, etc., smelted	178,424	54,410.26	1,883,347	8,634,226	4,293,278	15,380
Total, lode mines		180,151.00	4,390,817	74,266,000	25,352,000	31,072,000
Total, placers		7,880.00	2,609			
		188,031.00	4,393,426	74,266,000	25,352,000	31,072,000
Total, 1934		144,275.17	3,057,114	41,611,119	21,981,874	27,880,790

Mine production of metals from gold and silver mills in Nevada in 1935, by counties, in terms of recovered metals

County	Ore, old tailings, etc., treated		Recovered in bullion			
			Amalgamation		Cyanidation	
	Ore	Old tailings, etc.	Gold	Silver	Gold	Silver
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*
Churchill	4,760	-----------	1,480.50	1,240	-----------	-----------
Clark	8,161	850	1,077.02	437	400.46	670
Douglas	10	-----------	10.79	10	-----------	-----------
Elko	6,243	613	659.48	1,847	605.45	11,283
Esmeralda	20,900	[1] 532,674	3,790.13	1,475	8,828.23	209,216
Eureka	681	10	11.61	1	76.57	1,908
Humboldt	13,140	150	1,259.08	639	4,046.04	47,842
Lander	5,009	700	140.29	238	461.38	96
Lincoln	3,970	[2] 42,955	2.49	30	3,876.59	11,038
Lyon	81,707	4,000	14,685.02	52,751	261.49	5,125
Mineral	8,272	824	2,495.85	2,163	343.31	1,174
Nye	20,608	20,686	10,396.77	5,996	3,148.89	1,673
Ormsby	2	100	2.54	23	-----------	-----------
Pershing	12,959	7,100	901.41	4,655	3,781.35	7,483
Storey	34,133	1,389	4,237.04	12,832	2,465.92	44,011
Washoe	602	-----------	446.33	154	-----------	-----------
White Pine	1,898	2,140	275.85	62	8.70	5,398
Undistributed [3]	500	-----------	316.64	353	-----------	-----------
	223,555	614,191	42,188.84	84,906	28,304.38	346,917
Total, 1934	190,144	481,466	28,506.06	30,606	26,864.70	155,741

County	Concentrates and recovered metal				
	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Churchill	12	250.60	1,110	-----------	40
Clark	56	804.10	1,731	586	1,192
Elko	10	23.00	225	-----------	-----------
Esmeralda	194	3,073.81	4,802	175	11,896
Humboldt	11	15.20	242	-----------	-----------
Lander	2	14.45	42	-----------	30
Lyon	60	191.46	979	1,258	-----------
Mineral	61	334.99	330	805	25
Nye	115	294.33	305	-----------	-----------
Ormsby	2	5.10	7	-----------	-----------
Pershing	21	500.00	716	12	1,609
Storey	43	173.75	1,451	-----------	-----------
White Pine	26	364.09	121	-----------	-----------
	613	6,044.88	12,061	2,836	14,792
Total, 1934	294	3,061.16	9,509	242	6,240

[1] Yielded also 4,586 pounds of copper recovered from "cyanide" precipitates.
[2] Yielded also 78 pounds of copper and 278 pounds of lead recovered from "cyanide" precipitates.
[3] No information as to county of origin.

Gross metal content of concentrates from concentrating mills in Nevada in 1935, by classes of concentrates

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	5,127	14,229.66	513,263	8,968	190,582	-----------
Copper	119,271	30,399.41	107,755	67,578,541	449	-----------
Lead	19,863	3,808.04	1,215,503	48,742	20,973,063	2,060,000
Zinc	31,051	765.53	227,065	37,336	935,170	34,454,198
	175,312	49,202.64	2,063,586	67,673,587	22,099,264	36,514,198

Nevada ore and old tailings concentrated in 1935, by methods of concentration

Method of concentration	Ore and old tailings concentrated	Concentrates and metal content		
		Concentrates produced	Gold	Silver
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*
Flotation	3, 374, 667	175, 230	49, 022. 58	2, 061, 672
Table	1, 982	82	180 06	1, 914
	3, 376, 649	175, 312	49, 202. 64	2, 063, 586

Method of concentration	Concentrates and metal content—Continued					
	Copper		Lead		Zinc	
	Gross	Recovered	Gross	Recovered	Gross	Recovered
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Flotation	67, 672, 774	65, 623, 572	22, 084, 417	21, 029, 850	36, 514, 198	31, 056, 620
Table	813	702	14, 847	13, 802		
	67, 673, 587	65, 624, 274	22, 099, 264	21, 043, 652	36, 514, 198	31, 056, 620

Mine production of metals from concentrating mills in Nevada in 1935, in terms of recovered metals

BY COUNTIES

	Ore and old tailings treated		Concentrates and recovered metal					
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Clark	8, 798	25, 019	751	3, 000. 40	15, 137	11, 126	200, 402	
Elko	1, 740	1, 000	65	374. 40	5, 321	182	13, 118	
Esmeralda	306		26	21. 96	3, 484	91	9, 790	
Humboldt	8, 000		71	186. 56	29, 985	76		
Lander	698		30	5. 45	2, 510			
Lincoln	89, 022		34, 919	1, 646. 79	506, 126		9, 776, 728	24, 366, 053
Lyon	36, 514	500	528	1, 466. 24	40, 231			
Nye	106, 217		17, 617	1, 421. 15	944, 769	57, 897	11, 037, 500	6, 690, 567
Pershing	12, 750		319	371. 04	55, 174	3, 584	4, 126	
Storey	171, 845	17, 372	1, 578	10, 221. 06	256, 336	1, 393	474	
White Pine	2, 896, 868		119, 408	30, 487. 59	204, 513	65, 549, 925	1, 514	
	3, 332, 758	43, 891	175, 312	49, 202. 64	2, 063, 586	65, 624, 274	21, 043, 652	31, 056, 620
Total, 1934	2, 090, 569	12, 845	114, 427	27, 382. 88	1, 503, 512	40, 969, 788	18, 004, 635	27, 852, 155

BY CLASSES OF CONCENTRATES

	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous	5, 127	14, 229. 66	513, 263	6, 415	151, 576	
Copper	119, 271	30, 399. 41	107, 755	65, 550, 367	364	
Lead	19, 863	3, 808. 04	1, 215, 503	35, 731	20, 019, 665	
Zinc	31, 051	765. 53	227, 065	31, 761	872, 047	31, 056, 620
	175, 312	49, 202. 64	2, 063, 586	65, 624, 274	21, 043, 652	31, 056, 620

Gross metal content of Nevada concentrates produced in 1935, by classes of concentrates

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	5, 602	18, 004. 55	523, 981	9, 725	191, 063	
Copper	119, 285	30, 418. 60	107, 875	67, 581, 186	485	
Lead	19, 987	6, 058. 84	1, 216, 726	48, 992	20, 988, 690	2, 060, 000
Zinc	31, 051	765. 53	227, 065	37, 336	935, 170	34, 454, 198
	175, 925	55, 247. 52	2, 075, 647	67, 677, 239	22, 115, 408	36, 514, 198

Mine production of metals from Nevada concentrates in 1935, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	12	250. 60	1, 110		40	
Clark	807	3, 804. 50	16, 868	11, 712	201, 594	
Elko	75	397. 40	5, 546	182	13, 118	
Esmeralda	220	3, 095. 77	8, 286	266	21, 686	
Humboldt	82	201. 76	30, 227	76		
Lander	32	19. 90	2, 552		30	
Lincoln	34, 919	1, 646. 79	506, 126		9, 776, 728	24, 366, 053
Lyon	588	1, 657 70	41, 210	1, 258		
Mineral	61	334 99	330	805	25	
Nye	17, 732	1, 715. 48	945, 074	57, 897	11, 037, 500	6, 690, 567
Ormsby	2	5. 10	7			
Pershing	340	871. 04	55, 890	3, 596	5, 735	
Storey	1, 621	10, 394. 81	257, 787	1, 393	474	
White Pine	119, 434	30, 851. 68	204, 634	65, 549, 925	1, 514	
	175, 925	55, 247. 52	2, 075, 647	65, 627, 110	21, 058, 444	31, 056, 620
Total, 1934	114, 721	30, 444. 04	1, 513, 021	40, 970, 030	18, 010, 875	27, 852, 155

BY CLASSES OF CONCENTRATES

Dry and siliceous	5, 602	18, 004. 55	523, 981	7, 102	151, 999	
Copper	119, 285	30, 418 60	107, 875	65, 552, 341	389	
Lead	19, 987	6, 058. 84	1, 216, 726	35, 906	20, 034, 009	
Zinc	31, 051	765. 53	227, 065	31, 761	872, 047	31, 056, 620
	175, 925	55, 247. 52	2, 075, 647	65, 627, 110	21, 058, 444	31, 056, 620

Gross metal content of Nevada crude ore shipped to smelters in 1935, by classes of ore

Class of ore	Ore	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	130, 171	51, 287. 01	1, 521, 214	179, 404	355, 145	
Copper	17, 121	175. 79	15, 144	8, 385, 215	55, 434	
Lead	23, 587	2, 075. 32	288, 159	351, 179	4, 064, 539	
Copper-lead	135	5. 98	2, 134	3, 791	31, 342	
Lead-zinc	40		229		14, 606	19, 226
	171, 054	53, 544. 10	1, 826, 880	8, 919, 589	4, 521, 066	19, 226
Total, 1934	120, 942	51, 997. 30	1, 302, 664	733, 336	4, 066, 845	32, 914

Mine production of metals from Nevada crude ore shipped to smelters in 1935, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	618	195.15	30,998	372	7,193	
Clark	876	1,652.06	6,266	6,376	30,314	15,380
Douglas	11	16.49	15			
Elko	19,444	327.88	75,613	7,957,786	1,193,693	
Esmeralda	5,277	6,099.39	39,244	3,640	22,859	
Eureka	6,455	3,248.39	43,010	21,800	455,102	
Humboldt	602	502.28	10,264	1,364	17,486	
Lander	9,925	4,552.74	133,957	114,711	68,635	
Lincoln	25,576	3,592.85	278,655	339,746	2,005,560	
Lyon	639	352.08	4,628	81	946	
Mineral	6,474	3,257.88	35,510	63,632	39,873	
Nye	25,484	15,292.66	707,128	3,016	133,843	
Pershing	1,190	867.69	19,446	3,322	20,645	
Storey	1,190	812.08	18,646	234	873	
Washoe	248	87.70	4,237	8,305	12,994	
White Pine	67,005	12,669.91	418,472	81,120	198,302	
Undistributed [1]	40	16.87	791			
	171,054	53,544.10	1,826,880	8,605,505	4,208,318	15,380
Total, 1934	120,942	51,997.30	1,302,664	636,896	3,830,864	28,635

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous	130,171	51,287.01	1,521,214	166,894	273,748	
Copper	17,121	175.79	15,144	8,133,026	52,319	
Lead	23,587	2,075.32	288,159	302,964	3,842,302	
Copper-lead	135	5.98	2,134	2,621	29,725	
Lead-zinc	40		229		10,224	15,380
	171,054	53,544.10	1,826,880	8,605,505	4,208,318	15,380

[1] No information as to county of origin.

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1935, by counties and districts, in terms of recovered metals [1]

County and district [1]	Mines producing [2]		Ore, old tailings, etc.	Gold			Silver (lode and placer) [3]	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
Churchill County:			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Alpine	1		1	0.52		0.52	20		130		$38
Aspen	1		44	17.81		17.81	15				634
Bernice	2		60	5.32		5.32	2,066	129	1,676		1,749
Dixie	2		4,710	1,707.92		1,707.92	2,331	83	40		61,461
Eagleville	1		48	8.70		8.70	869				929
Eastgate	1		34	8.73		8.73	473				646
Fairview	3		169	97.17		97.17	8,216	121	4,114		9,481
Holy Cross	3		60	18.25		18.25	4,587	39	1,273		3,990
Jessup	2		12	8.37		8.37	8				299
Sand Springs	1		7	10.70		10.70	115				457
Wonder	2		233	42.76		42.76	14,648				12,025
Clark County:											
Alunite	1		5	3.09		3.09	1				109
Boulder Dam		(4)			0.84	.84					29
Crescent	3		536	93.04		93.04	1,504		1,179		4,385
Eldorado Canyon	11	(4)	3,565	856.89	11.41	868.30	7,359	443	2,271		35,807
Gold Butte	4	(4)	131	156.28	.85	157.13	65	35	174		5,556
Searchlight	35	(4)	29,617	3,825.62	2.96	3,828.58	12,317	9,195	72,271		146,507
Yellow Pine	10		9,852	2,011.82		2,011.82	3,072	8,435	156,013	15,380	80,239
Douglas County:											
Gardnerville	1		5	11.20		11.20	6				396
Mt. Siegel		(4)			3.72	3.72	1				131
Mountain House	2		10	8.11		8.11	10				291
Red Canyon	1		5	6.27		6.27	3				222
Wellington	1		1	1.70		1.70	6				64
Elko County:											
Centennial	2		546	78.00		78.00	191	182	2,575		2,985
Charleston	1	(4)	96	25.20	2.48	27.68	25	279			1,010
Contact	4		286	35.10		35.10	181	12	51,006		3,400
Cope	5	(4)	15,831	25.47	2.25	27.72	5,875	7,945,916	43,783		666,455
Cornucopia	1		10	1.18		1.18	211		30		194
Delano	5		2,239	7.69		7.69	37,605	618	640,608		52,973
Gold Circle	11		5,492	1,016.03		1,016.03	12,567				44,594
Island Mountain	2	2	36	33.71	44.90	78.61	87				2,814
Jarbidge	10		2,810	606.33		606.33	5,888	29			25,456
Loray	1		9	.49		.49	681	315			533

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1935, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore, old tailings, etc.	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Elko County—Continued.											
Lucin	1		3	.10		.10	27		1,532		$84
Mardis	3		33	81.20		81.20	85	599			2,953
Mud Springs	1		35	.35		.35	561	55	6,624		685
Pilots Peak	1		4				10	679			64
Rock Creek	1		2	7.90		7.90	904				926
Rowland	1		65	7.80		7.80	3				275
Spruce Mountain	6		1,735	18.34		18.34	31,343	9,284	511,396		44,396
Tuscarora	5	3	64	45.32	36.34	81.66	912				3,514
Esmeralda County:											
Desert	5	2	713	124.97	21.11	146.08	792		238		5,692
Divide	8		2,356	917.70		917.70	30,636	743	15,948		54,839
Dyer	1		69	5.80		5.80	2,884	130	493		2,306
Goldfield	8	(4)	349,212	7,066.10	4.35	7,070.45	3,449	7,066	84		250,535
Hornsilver	3		1,634	305.15		305.15	3,591	34			13,264
Klondike	1		200	16.96		16.96	3,109	66	9,717		3,222
Lida	1	5	32	5.90	519.19	525.09	378	25	73		18,655
Lone Mountain	3		8,019	1,663.01		1,663.01	5,049		320		61,847
Oneota	1		10	2.64		2.64	2				94
Silver Peak	7		17,916	9,026.65		9,026.65	5,143	312	17,248		320,345
Sylvania	1	1	3		3.42	3.42	170	116	424		268
Tonopah [5]	1	(4)	178,994	2,820.44	.97	2,821.41	203,260				244,842
Tule Canyon		(4)			.38	.38					13
Eureka County:											
Cortez	1		44	2.97		2.97	3,829	142	1,268		2,919
Eureka	16		6,809	2,298.81		2,298.81	40,972	20,644	482,033		130,902
Lynn	3	8	253	310.41	660.57	970.98	126	170			34,089
Maggie Creek	2		143	787.62		787.62	433	1,158	403		27,990
Mineral Hill	1		48	2.56		2.56	891	103	958		777
Humboldt County:											
Awakening	4		496	521.83		521.83	299				18,479
Boyd Basin	1		920	108.23		108.23	62				3,833
Central	4		123	293.07		293.07	784		1,506		10,881
Dutch Flat	1	1	15	4.09	5.14	9.23	13				332
Gold Run	3	6	43	8.26	41.99	50.25	1,471		12,753		3,326
Jackson Creek	1	(4)	62	41.36	3.90	45.26	49				1,619
National	2		10,936	4,257.05		4,257.05	50,693	76			185,439
Paradise Valley	1		8,000	186.56		186.56	29,985				28,081
Potosi	1		3	.10		.10	85				65
Rebel Creek	2	(4)	7	7.95	1.91	9.86	184		29		479
Sawtooth		8			44.59	44.59	8				1,566
Sherman	1		100	81.69		81.69	64				2,905

Varyville	1	2	15	5.63	7.08	12.71	7				450
Warm Springs	1	1	800	333.16	11.88	345.04	41				12,106
Winnemucca	8	2	372	160.18	5.25	165.43	5,251	1,364	3,198		9,805
Lander County:											
Battle Mountain	33	10	8,207	3,880.65	1,009.88	4,890.53	42,169	66,363	33,983		203,345
Bullion	9	9	5,304	697.42	383.09	1,080.51	13,474	44,742	5,050		51,418
Hilltop	5		706	343.80		343.80	23,246				28,741
Kingston	1	1	15	23.31	2.51	25.82	362				1,164
Lewis	4		715	65.43		65.43	40,432	2,741	14,188		32,146
McCoy	2	1	224	89.22	17.53	106.75	1,107	218	742		4,580
Mud Springs		1			8.59	8.59	1				301
New Pass	3		195	40.97		40.97	92				1,500
Reese River	8		966	33.51		33.51	16,179	647	14,702		13,443
Tenabo		(4)			2.98	2.98					104
Lincoln County:											
Atlanta	1		133	1.90		1.90	2,759	97			2,058
Caliente	3		237	160.41		160.41	1,808				6,914
Comet	2		618	38.93		38.93	13,420	898	160,702		17,511
Eagle Valley	7	(4)	748	152.40	2.02	154.42	2,068	1,559	263		7,031
Ferguson	5		44,468	4,129.15		4,129.15	11,536	97	358		152,834
Freiburg		1			13.34	13.34	14				477
Highland	1		498	69.72		69.72	3,236	23,555	8,238		7,051
Jack Rabbit	2		15,344	200.14		200.14	163,923	331,869	1,698,583		220,313
Pioche	9		98,784	4,382.17		4,382.17	554,516	9,174	9,910,336	24,366,053	2,021,215
Tempiute	3		1,347	10.06		10.06	47,568	859	8,696		34,961
Viola	1		1	.04		.04	41				31
Lyon County:											
Palmyra	2		61,516	2,388.98		2,388.98	42,574	21	29		114,217
Ramsey	1		1,513	155.82		155.82	21				5,469
Silver City	24	6	59,917	14,388.06	54.31	14,442.37	59,004	1,286			547,999
Talapoosa	1		354	131.52		131.52	3,040		917		6,825
Yerington	3		65	30.11		30.11	4	32			1,059
Mineral County:											
Aurora	6		123	130.72		130.72	2,113	761	1,248		6,207
Bell	3	1	651	273.82	2.46	276.28	439				9,985
Buena Vista	3		29	3.70		3.70	891	129	2,340		874
Columbus	1		1	4.60		4.60	486		47		512
East Walker	2	2	7	23.14	145.64	168.78	24	10			5,925
Fairplay	1		91	6.26		6.26	2,282				1,859
Fitting	2		62	123.39		123.39	10	39			4,329
Garfield	1		238	281.28		281.28	8,136	610	16,077		16,386
Gold Range	1		254	77.29		77.29	56				2,745
Hawthorne	9	1	432	697.62	2.51	700.13	11,507	1,386	8,088		33,214
Monte Cristo	1		6	1.94		1.94	1				69
Mount Grant	1		8	7.03		7.03	1				247
Pilot Mountain	9		977	341.43		341.43	1,578		3,001		13,204
Pine Grove	2		1,182	425.99		425.99	1,170	805	25		15,818
Rand	5		111	103.32		103.32	1,612				4,775
Regent	8	4	100	248.26	54.64	302.90	1,467	37			11,659

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1935, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore, old tailings, etc.	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Mineral County—Continued.											
Santa Fe	3		219	90.18		90.18	170	51			$3,283
Silver Star	14		7,443	2,876.06		2,876.06	5,690	316	9,119		105,143
Simon	1		3,637	720.60		720.60	2,089	60,293			31,727
Nye County:											
Athens	2		382	136.83		136.83	906				5,440
Belmont	1		1	.08		.08	86				65
Broken Hills	1		366	142.29		142.29	6,682	1,962	110,169		14,352
Bruner	3		725	732.34		732.34	5,538		6,923		29,889
Bullfrog	11	1	1,095	550.13	2.12	552.25	2,458	366	72		21,129
Cloverdale	3		71	7.81		7.81	2,814	99			2,304
Eden Creek	2	1	102	2.82	7.01	9.83	197				486
Ellendale		(4)			2.09	2.09					73
Fairplay	6		72	19.21		19.21	787	68	1,528		1,305
Hannapah	1		50	1.50		1.50	846				661
Jackson	2		71	82.42		82.42	566		2,258		3,382
Johnnie	1	3	535	118.57	28.25	146.82	18				5,152
Mammoth	3	1	535	36.84	10.34	47.18	37				1,678
Manhattan	16	21	36,475	11,771.85	527.40	12,299.25	4,378				433,620
Millett	3		315	153.24		153.24	221				5,522
Reveille	2		2	2.04		2.04	6		39		77
Round Mountain	6	1	7,792	7,217.36	2,799.07	10,016.43	8,561				356,728
Santone	1		3	.50		.50	103		876		127
Silverton	1		89	1.02		1.02	1,419				1,056
Tolicha	2		99	51.62		51.62	19				1,820
Tonopah [5]	16	1	17,716	7,886.19	1.22	7,887.41	671,600	191	4,699		758,976
Troy	1		73	28.03		28.03	94				1,049
Union	6	1	269	124.79	7.99	132.78	7,300	302	7,061		10,202
Ormsby County:											
Carson River	1		100	7.40		7.40	9				265
Voltaire	(4)		2	.24		.24	21				23
Pershing County:											
Antelope	8	2	904	523.10	29.66	552.76	7,130	361	7,188		24,789
Arabia	2		14	11.17		11.17	326				625
Imlay	8	4	7,220	210.61	35.86	246.47	4,126		4,406		11,768
Kennedy	5		282	243.32		243.32	5,821	2,924	701		12,971
Placerites		2			77.34	77.34	18				2,720
Rochester	6	3	12,978	501.68	64.15	565.83	57,931	3,633	12,549		62,245
Rosebud	5	3	377	142.57	681.32	823.89	2,877				30,904
Sawtooth		3			22.50	22.50	3				790
Seven Troughs	9	1	11,090	4,278.55	34.04	4,312.59	8,303				156,908
Sierra	10	7	1,134	510.49	78.90	589.39	1,041		1,536		21,438

Storey County: Comstock	34	1	225,929	17,909.85	10.46	17,920.31	333,283	1,627	1,347		866,947
Washoe County:											
Pyramid	2		66	2.79		2.79	904	6,766			1,309
Washoe	2	1	95	5.01	1.21	6.22	2,375	552	12,013		2,451
White Horse	9	3	689	526.23	12.91	539.14	1,118	987	981		19,795
White Pine County:											
Aurum	2		1,326	15.81		15.81	53,819		133		39,241
Cherry Creek	12		10,039	1,831.13		1,831.13	85,309				125,405
Duck Creek	2		461	106.50		106.50	1,322		27,757		5,788
Eagle	1		77	2.48		2.48	1,445	200	54,268		3,313
Granite	7		103	50.26		50.26	89	256	395		1,860
Osceola	3	9	11,089	617.34	242.56	859.90	98,418	203	1,514		100,912
Peacock	1		21	5.96		5.96	7				214
Robinson	27		2,931,749	41,046.85		41,046.85	302,759	65,629,700	80,479		7,104,732
Taylor	2		15,442	287.54		287.54	104,656				85,285
Ward	1		1,591	239.27		239.27	19,077				22,086
White Pine	7		2,310	79.86		79.86	7,502	686	32,857		9,558
Undistributed[6]	4	2	106,699	1,819.83	66.62	1,886.45	948,227	57,925	11,040,131	6,690,567	1,488,362
Total Nevada	706	149	4,392,819	180,151.00	7,880.00	188,031.00	[3] 4,393,426	74,266,000	25,352,000	31,072,000	18,284,186

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures; other producing districts listed in footnote 6 and output included under "Undistributed."
[2] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[3] Of the total silver, 4,390,817 ounces came from lode mines and 2,609 ounces from placers.
[4] No information as to number (see footnote 2).
[5] Tonopah district lies in both Esmeralda and Nye Counties.
[6] Includes following districts: Tybo, Nye County, and Black Horse, White Pine County.

CHURCHILL COUNTY

Fairview district.—The Nevada Mines, Inc., worked the Nevada Hills mine in 1936 and made a number of shipments of gold-silver ore in December; a 40-ton cyanide plant was under construction. The Lena and the Chalk Mountain mines were both active.

Wonder district.—Lessees worked the Nevada Wonder mine from June 1936 until the end of the year and made a number of shipments of gold-silver ore for smelting.

Other districts.—Prospecting, development, and a small output were reported from the Alpine, Aspen, Holy Cross, Jessup, and Sand Springs districts during 1936.

CLARK COUNTY

The completion of Boulder Dam was the most important event in Clark County during 1936, and the mining interests of the area expressed the hope that cheap electric power from this source would contribute to the further revival of the local mineral industries. So far, however, higher prices for the metals had been the principal factor in improving mining conditions.

Crescent district.—Several small operations were reported in the Crescent district in 1936, including work on the Budget, the Treasure, and the Colonel Sellars property. Ore was shipped both for smelting and for treatment at custom mills at Searchlight about 20 miles to the east.

Eldorado Canyon district.—The Eldorado-Rand Mining Co. treated a large quantity of tailings by cyanidation and concentration between June and October 1936; gold was the principal metal recovered. Activities were also reported at the Boulder Eldorado, Duncan, Techatticup, Silver Legion, Dolores, and Yellow Ned properties.

Searchlight district.—The Searchlight district was the outstanding producer in Clark County in 1936, and its old mines were actively developed. Most of the mills in the camp depended more or less upon custom ore, and the opportunity for lessees and sublessees usually was greater than in other Nevada districts. The Mollin Mining Co. operated a flotation mill at the Quartette mine and treated principally old tailings; some custom milling was also done. The Esler Douglas amalgamation mill treated ore for a number of shippers, most of whom were local lessees. The Kelsey Mining & Milling Co. cyanided ore and old tailings for various shippers. The Blossom mine, one of the larger producers of the district, was operated by lessees and sublessees.

Yellow Pine district.—The Chiquita mine was the largest producer in the Yellow Pine district in 1936. The company operated a 100-ton cyanide plant; the recovered content was mostly gold. The mill at the Keystone Barefoot property was operated largely on custom ore, and the mine itself was worked by lessees. The Golden Chariot was worked throughout the year, and 500 feet of development work were done. Smaller production was reported at the Boss, Red Cloud, Yellow Horse, and Clementina mines.

DOUGLAS COUNTY

Amalgamation of a small quantity of gold ore in 1936 was reported at the Mammoth mine in the Silver Glance district.

ELKO COUNTY

Contact district.—Lessees worked the Delano group in 1936.

Cope district.—The Mountain City Copper Co., subsidiary of the International Smelting Co., operated the Mountain City mine throughout 1936 and was the largest producer of high-grade copper ore in the United States. During the year a 300-ton flotation mill was built, and over 4,700 feet of development work were done. Before the mill was completed large quantities of ore averaging over 25 percent copper were shipped; the precious-metal content of the ore was negligible. The company paid dividends for the first time in 1936 and by the close of the year had distributed $497,810.67.

Delano district.—Lessees developed the Cleveland and Hendrix claims during 1936; a small quantity of lead ore resulting from this work was shipped. Lessees on the Delno mine shipped considerable argentiferous lead ore. Favorable results were reported from development work at the Rainstorm, Larabelle, and Johnny Boy group of claims.

Gold Circle district.—The companies operating near Midas continued production and development at their properties throughout 1936. The largest operation was that of the Gold & Silver Circle Mines, Inc., on the Elko Prince and Missing Link mines; in addition, the company did considerable custom milling for other properties nearby. The gold ore mined also contained a substantial amount of silver and was treated at a countercurrent cyanidation mill. The Buena Gold Mines, Inc., worked the Esmeralda mine throughout the year and treated the ore by amalgamation and cyanidation. As at the Elko Prince and Missing Link properties, the value of the ore was in both gold and silver. The Sleeping Beauty was developed by the East Standard Mining Co., which drove 400 feet of development headings during the year; the ore taken out was stored on the dump. More than 1,000 tons of old tailings were shipped from the Kansas mine to the Gold & Silver Circle mill for treatment.

Jarbidge district.—The Elkoro Mines Operating Co. worked the Elkoro mine, the outstanding producer in the Jarbidge district in 1936. The ore was treated in a 250-ton flotation mill, and the concentrates containing gold and some silver were shipped to a smelter. This mine was shut down in 1932 as worked out, but the higher prices for gold and silver have made its reopening possible. The Alpha mine was operated intermittently during the spring and summer months; the ore produced was treated by amalgamation and the sands by cyanide leaching.

Lime Mountain district.—The Lime Mountain Consolidated worked throughout 1936 and shipped copper ore for smelting; almost 1,000 feet of drifts and raises were driven. The ore was reported to contain considerable copper and zinc in addition to the precious metals.

Mardis district.—A new tunnel 160 feet long was driven at the Virginia mine in 1936, and a small quantity of ore resulted from this development.

Railroad district.—Lessees worked the Sweepstake mine in 1936 and made a number of shipments.

Spruce Mountain district.—The Black Forest mine was worked by the Missouri Monarch Consolidated Mines Co. throughout 1936. Over 1,600 feet of development work were done, and the ore produced therefrom was shipped for smelting. Although the ore is complex it

is mined chiefly for its lead and silver content. The Nevada Lead & Zinc Co. shipped ore of similar type.

Tuscarora district.—Prospecting and development work was carried on in the Tuscarora district in 1936, and small quantities of lode and placer gold were produced.

ESMERALDA COUNTY

Desert district.—Three lessees worked in the Mammoth and Last Chance mine in 1936 and treated their output by amalgamation in a 15-ton Chilian mill; some other small operations were reported in the district.

Divide district.—Various lessees shipped considerable gold-silver ore in 1936 from the property of the Tonopah Divide Mining Co. for smelting. The property of the Brougher Divide Mining Co. was likewise worked by lessees, and the silver ore produced was shipped to a smelter. Lessees carried on development work at the Diamondfield Daisy and Texas Kelly mines, and production was reported from each.

Goldfield district.—An increase of mining activity in the Goldfield district in 1936 was brought about by exploration work (following geological recommendations) by the Eastern Exploration Co. operating as a subsidiary of the Calumet & Hecla Consolidated Copper Co. The exploration work was done on the properties of the Goldfield Consolidated, Goldfield Deep Mines Co. of Nevada, Jumbo Extension Mining Co., and East Extension Mining Co. Although the tonnage of ore produced was small, some of it had a gold content reminiscent of early-day production, and its total gross value was large. Development work exceeded 13,000 feet. An enlarged changehouse and a new compressor were added to the surface equipment. The other large producer in the Goldfield district was the Bradshaw Syndicate, Inc., which held a lease on the tailings of the Goldfield Consolidated Mines Co. Except in the winter months this company operated a 1,400-ton cyanidation plant throughout the year and treated 325,000 tons of old tailings with a large recovery of gold. The Jumbo Extension Mining Co., Reorganized Silver King Divide Mining Co., and Imperial Development Co. were among other operators in the district.

Hornsilver district.—The Ohio Mines Corporation operating the Orleans group in 1936 continued to be the principal producer in the Hornsilver district. The company treated its ore in a 75-ton flotation mill and shipped the concentrates for smelting. The value of the ore lies chiefly in gold, but silver was a substantial contributor to the revenue. A number of smaller operators were reported active in the district.

Lida district.—The Bonanza property in the Lida district was operated throughout 1936 and gold ore was shipped for smelting; 200 feet of development work were reported. A 20-ton concentrating mill was built at the Ingalls mine, where some ore was treated and concentrate produced in a test run. There was also some placer production in the district, particularly in the Tule Canyon section where the Los Angeles Rock & Gravel Corporation operated a large dry-land dredge.

Lone Mountain district.—The Weepah mine was operated by the Weepah Nevada Mining Co. and was the only producer of importance in the Lone Mountain district in 1936. The company used the open-cut method of mining and loaded the ore by power shovel into trucks

for delivery to its 250-ton amalgamation and flotation mill. Part of the gold in the ore was recovered by amalgamation, but the flotation unit accounted for the recovery of the bulk of the silver. The construction of a 300-ton cyanidation plant was reported started at the end of the year.

Silver Peak district.—The revival of mining activities in the Silver Peak district continued throughout 1936, and the Mary mine of the Black Mammoth Consolidated Mining Co. was the largest producer in Esmeralda County. The ore was treated in a 100-ton cyanidation plant; gold was the metal of principal value recovered. The Brodie mine was purchased from R. H. Gordon and the Gordon Mines, Inc., by the International Smelting Co. on April 9. The new company did 931 feet of development work and treated its ore in a 15-ton amalgamation-flotation mill. The principal value of the ore is the gold content. Humphrey & Holt operated a 50-ton cyanide-leaching plant on old tailings in the district.

Tonopah district (see also Nye County).—The General Metals Recovery Corporation, leasing the huge tailings dump at Millers from The Tonopah Mining Co. of Nevada, was one of the large producers of gold and silver in Esmeralda County during 1936. These tailings were the result of early-day treatment of Tonopah ores before water had been developed at the mines themselves; Millers was the nearest point at which abundant water was available. The mines of the Tonopah district lie several miles to the east in Nye County.

EUREKA COUNTY

Buckhorn district.—The Buckhorn Mining Co. started operation on the Buckhorn mine in April 1936. A 100-ton flotation mill was built, and milling was begun on November 1. Concentrate valued principally for gold was shipped for smelting.

Cortez district.—Ore shipments were made from the property of the Consolidated Cortez Silver Mines Co. and from the Schultes mine during 1936. The former shipped silver ore and the latter gold-silver ore.

Diamond district.—A small quantity of lead ore was shipped in 1936 from the Silver Bell property.

Eureka district.—The Eureka Prospect worked throughout 1936 on the Diamond Excelsior property and recovered a large quantity of gold and a substantial quantity of silver by cyanidation. A little gold ore was shipped. The mill ore was given a chloridizing roast before cyanidation. A number of lessees working in Eureka district made numerous shipments of argentiferous lead ore.

Lynn district.—The Big Six property was worked in 1936 by a lessee, who made a number of shipments of gold ore for smelting. Most of the operations in the Lynn district, however, were on placer ground. Placer production was reported from the Arrowhead, Big Six, Bullfrog, Gold Coin group, Golden Tip, Hilltop, Last Chance, Mayday, Payday, and Spotted Horse properties. Much of the work was done by small-scale hand methods, but a small power shovel and special concentration machine were reported on the Golden Tip property. Both wet- and dry-concentration methods were emp'

HUMBOLDT COUNTY

Awakening (Amos) district.—The Awakening district in the Slumbering Hills, a few miles south of Sodhouse, was the scene of Nevada's most spectacular gold rush of 1936. In 1935 two prospectors located some claims in this area, which were subsequently taken over by George B. Austin, of Jungo. The mine was named the Jumbo, and the grass-roots ore proved rich enough to make the mine virtually self-financing. By the end of the year the deepest work was about 150 feet below the surface, and a 25-ton mill was amalgamating the ore produced. The publicity incident to the Jumbo development resulted in a small rush to the district and in considerable prospecting and development work.

Boyd Basin district.—The Homer Verne mine was operated from April to November 1936 under lease and produced a small quantity of gold ore which was treated by amalgamation.

Gold Run district.—A number of small operations were reported in the Gold Run district during 1936.

Leonard Creek district.—Operations on the Black Rock and Treadwell properties were turned over by E. F. Nieman on November 5, 1936, to the Columbia Mines, Inc. During the year several lots of gold ore were shipped for smelting, and over 600 feet of development work, including 80 feet of sinking, were done.

National district.—The Buckskin-National mine, worked by the Nevada Lucky Tiger Mining Co., was the largest operation in the National district in 1936. A large quantity of ore and a smaller quantity of old tailings were treated at an all-slime cyanidation plant having a daily capacity of 50 tons. Development headings were driven 350 feet during the year. The National mine was worked by lessees who shipped bullion and ore during the year.

Potosi district.—The Getchel Mines, Inc., employed an average of 25 men during 1936 in developing its property on Kelly Creek in the Potosi district; 2,990 feet of development work were done.

Sawtooth district.—A number of operators were reported using dry-washing methods on the Black Joe property during 1936.

Winnemucca district.—The Humboldt mine shipped several lots of gold ore and the Pansy Lee shipped gold-silver ore in 1936 for smelting.

LANDER COUNTY

Battle Mountain district.—Several mining operations were active in the Battle Mountain district during 1936. The properties of the Copper Canyon Mining Co. were operated both on company account and by lessees who shipped a large quantity of copper ore for smelting. Over 2,500 feet of development work were done on the property, not including that done in the leased sections. The company operations were restricted to the development of the gold-bearing sections of the Canyon mine, while the lessees' work was confined to the Copper Basin properties. No stoping was done by the company. Ore shipments to a smelter were reported from the Bailey Day, Buzzard, Florence, Gold Butte, Gold Crown, Harriet, Lucky Strike, Morning Glory, and Morning Star properties. A tailings dump at the New Bonanza mine was treated by flotation.

Bullion district.—A large quantity of gold ore was treated by cyanidation in a 30-ton cyanide-leaching plant at the Gold Acres mine in

1936. Smelter shipments of gold ore were made from the Gold Pan and Gelding properties. The Gray Eagle Mining Co. shipped a small lot of gold-silver ore for smelting and did 100 feet of development work during the year. Expansion of operations was projected at this property for 1937. A number of placer operations were reported in the Bullion district; most of the gold recovery was by dry-washing methods.

Hilltop district.—Ores containing considerable quantities of gold and silver were shipped from the Blue Dick, Hilltop, and Paymaster properties in 1936.

New Pass district.—Ore produced at the Thomas W. mine was amalgamated in a 5-stamp mill in 1936.

Pittsburgh district.—Several operators were reported to have shipped ore from the Pittsburgh district in 1936.

Reese River district.—The Austin Silver Mining Co. was the largest operator in the Reese River district during 1936. This company not only treated considerable ore from both underground workings and dumps but also did some custom milling during the year.

LINCOLN COUNTY

Comet district.—Lessees operated the Prince mine throughout 1936 and shipped a considerable tonnage of lead ore for smelting. Copper ore was shipped from the Comet mine, and 128 feet of development work were done during the 3 months the mine was worked.

Eagle Valley district.—The Blue Bird group was worked by the Blue Bird Mining Co. throughout 1936. This company operated a 25-ton flotation mill during the earlier part of the year and made several shipments of concentrates. During the latter part of the year crude ore was sent to a smelter.

Ferguson district.—The Caliente Cyaniding Co. cyanided a large quantity of old tailings in 1936, which yielded gold and a little silver. A small tonnage of gold ore was shipped for smelting from underground operations at the Delamar property.

Groom district.—Smelting ore was shipped in 1936 from the Kelly and Groom properties in this area.

Highland district.—In 1936 the Highland Queen and the Whaley mines produced lead and silver ores, respectively, for shipment to a smelter.

Jack Rabbit district.—Lessees shipped ore, carrying silver, copper, and lead, from the Ida May mine in 1936.

Pioche district.—The Pioche district continued in 1936 to be one of the leading mining districts in Nevada; during the year it was the largest producer of lead and zinc in the State. The Combined Metals Reduction Co., operating a large group of claims in the district, treated its ore by selective flotation at Bauer, Utah; the concentrates containing zinc, lead, silver, and gold were shipped for smelting. The Pioche Mines Consolidated was another very large operator in the camp. Most of the ore produced was treated by flotation, although a small quantity was shipped crude. The principal value of its ore is in silver, gold, and lead. Over 1,700 feet of development work were done during the year. Several small operators were reported in the district, most of whom were leasing.

Tempiute district.—The Tempiute Mining Co., working the Sterling group, was the largest producer in the Tempiute district in 1936. This company shipped silver ore to a smelter.

LYON COUNTY

Palmyra district.—At the beginning of 1936 the Como Mines Co. and the Stone Cabin Consolidated Mines, Inc., employed large forces at mines of this district. Before the close of the year, however, both companies had stopped operations.

Pine Grove district.—The Cambridge Mining Co. reopened an old mine 24 miles southeast of Yerington and treated a small quantity of ore in 1936 by amalgamation and table concentration.

Silver City district.—The Dayton Consolidated Mines Co. was the largest operator in Lyon County in 1936 and one of the leading gold producers of the State; the ore was treated in a 125-ton cyanide plant, and large quantities of gold and a little silver were recovered. The Trimble stamp mill (amalgamation) and the Donovan cyanide plant, both of which did custom work, were features of the mining activities of the Silver City district and were important factors in making possible the operation of many of the small mines there. The South Comstock Gold Mines, Inc., worked intermittently during the year, operating its 50-ton amalgamation and flotation mill. Part of the ore was produced by lessees. The Dayton Douglas Cyanidation Co. continued to leach the Dayton tailings in its open-air cyanide plant. In addition to the output of numerous lessees who worked lode properties in the district, a small quantity of placer gold was produced.

MINERAL COUNTY

Garfield district.—The West End Consolidated Mines Corporation of Tonopah leased its Mable mine during 1936; lessees made a number of shipments of lead ore and recovered some bullion by amalgamation.

Pilot Mountain district.—Ore produced during the 6 months the open-cut at the Belleville mine was operated in 1936 was treated by amalgamation.

Pine Grove district.—The Sunny Slope property was operated the last 2 months of 1936; a small quantity of gold was recovered at its 5-stamp amalgamation mill.

Regent district.—A number of small operators worked mines in the Regent district in 1936. Several carloads of gold ore were shipped from the Morning Star mine. Gold ore was shipped from the Black Eagle property also.

Santa Fe district.—Shipping ore was produced in 1936 at the New Year claims in the Santa Fe district.

Silver Star district.—A large number of properties were operated in the Silver Star district during 1936. The Hyde group of claims was worked by leasers. The Mary Ann and Triumph group yielded ore which was treated by amalgamation. Production of shipping ore was reported at the Cleopatra mine.

NYE COUNTY

Athens district.—Lessees worked the Warrior mine during 1936.

Bellehelen district.—Lessees were active at several mines in the Bellehelen district in 1936.

Bullfrog district.—The General Milling Corporation, working the Homestake property in 1936, treated a large quantity of ore in its 100-ton amalgamation-concentration mill. A number of shipments of gold ore were made from the Polaris property. The Gibraltar Gold Mining Co. treated a little ore in a 50-ton flotation mill.

Jackson district.—The Last Chance Mining Syndicate did 350 feet of development work and extracted a small quantity of ore from the Petersen mine in 1936; part of the ore was shipped and the remainder amalgamated. The War Eagle property shipped gold ore for smelting. This company reported that its 300 feet of new development work had located a vein on the hitherto unprospected side of a fault. Development and production were also reported at the Evening Star and Raindrop group.

Johnnie district.—A number of small dry-placer operations were reported in the Johnnie district during 1936.

Mammoth district.—Ore was reported amalgamated at the Eary mine in 1936.

Manhattan district.—The Manhattan district was one of the most active in the State during 1936. The Goldfields of America, Ltd., carried on an extensive exploration campaign at the Mayflower and Union No. 9 properties, during which a considerable tonnage of ore was treated in a 50-ton amalgamation mill. The Manhattan Consolidated Mines Development Co. was active throughout the year. Lessees worked the property of the Nevada Coalition Gold Mines Co. and produced considerable ore, of which part was treated by amalgamation and the remainder shipped for smelting. The Reliance Mining Co. operated the Verden mine, treating both ore and tailings by amalgamation and flotation. The White Caps Gold Mining Co. worked the White Caps mine and treated a large quantity of old tailings and ore in a 100-ton cyanide plant. Development work amounted to 500 feet during the year. Other properties on which work was reported were the April Fool, Five Brothers, Jumping Jack, and Owl. Many lessees produced placer gold from the properties of the Cole-Kirchen Syndicate.

Phonolite district.—The Penelas Mining Co., the only large operator in the Phonolite district in 1936, treated by cyanidation the gold ore extracted from its Penelas mine. Approximately 1,000 feet of development work were done during the year.

Quartz Mountain district.—A number of shipments of lead ore were made in 1936 by a lessee on the San Rafael mine.

Round Mountain district.—The principal property in the Round Mountain district in 1936 was the group of claims owned by the Nevada Porphyry Gold Mines, Inc., which was optioned to the A. O. Smith Corporation in the middle of the year. It was reported that the option was extended into 1937. The property includes lode and placer ground. A very large flow of water was piped many miles into the district for use in gold-recovery plants.

Silver Bow district.—Ore was reported shipped in 1936 from the Silver Bow district.

Tonopah district (*see also Esmeralda County*).—The Tonopah district was given over almost entirely to lessees during 1936. Large quantities of silver and gold-silver ore were shipped from the Tonopah Belmont and the Tonopah Extension and from properties of the West End Consolidated Mines Corporation and the Tonopah Mining Co. of Nevada.

Tybo district.—The Tybo mine of the Treadwell Yukon Co., Ltd., was operated throughout 1936; the company 300-ton flotation mill worked steadily until the middle of December. The Tybo district is second only to the Pioche district in production of lead and zinc.

153336—37——30

The value of silver contained in the lead and zinc concentrate shipped accounted for almost half of its gross value.

ORMSBY COUNTY

Voltaire district.—The Gold Edge and Athens mines were under development in 1936.

PERSHING COUNTY

Antelope (Scossa) district.—The Hawkeye was worked from March 1, 1936, to the end of the year, and the ore produced was treated in a small ball mill by amalgamation. A small production was reported from the Haystack mine which was reopened and renamed the Gold Star.

Buena Vista district.—An old tailings pond was treated in 1936 at a small cyanide-leaching plant on the Star Peak property.

Kennedy district.—Shipments of gold ore in 1936 were reported from the Gold Note and Black Hawk properties.

Rochester district.—The Rochester Plymouth Mines Co. operated a flotation mill in 1936 and shipped concentrates for smelting. Silver ore was shipped from the Crown Hills and Olive properties. Gold ore produced at the Great Western Mines Co. properties was amalgamated. The Rhyolite Placers operated a gas shovel and stationary washing plant in Limerick Canyon and produced considerable placer gold.

Rosebud district.—The Golden Juniper mine was operated under lease by Linticum & Causten from the middle of August 1936 until near the end of the year. The ore was crushed to 10-mesh and given a cyanide leach. Most of the operators in the Rosebud district, however, operated dry placers. Small placer operators using hand methods were more successful in this district than in any other district of the State.

Seven Troughs district.—A number of small operators, several of them lessees, produced considerable ore in the Seven Troughs district during 1936.

Sierra district.—In 1936 several mines, both lode and placer, were operated in the Sierra district; the Black Hole mine of the White Bear Mining Co. was one of the largest.

STOREY COUNTY

Comstock district.—The Arizona Comstock Corporation, working the Savage, Hale & Norcross, and Chollar-Potosi, treated a large quantity of ore at its 400-ton flotation-cyanidation plant in 1936; the cyanide plant handles 5 tons of concentrates a day. Most of the ore was derived from the company open-cut, where it was loaded with power shovels into trucks for delivery to the mill. In the Gold Hill section of the Comstock Lode the leading producers were the Consolidated Chollar Gould & Savage Mining Co. Overman mine from which a large tonnage of ore, principally from dumps, was treated in a 300-ton flotation mill, and the Sutro Tunnel Coalition, Inc., Crown Point mine from which a large tonnage of gold-silver ore was treated in its 100-ton cyanide plant. Over 1,300 feet of development work were done at the Overman mine and approximately 1,000 feet at the Crown Point during the year. The Sierra Nevada, Ltd., working the Sierra Nevada mine at the northern end of the "Lode", treated its ore in a

125-ton flotation plant; considerable gold and silver were recovered from the resulting concentrates. Lessees operated many small mines in the district.

WASHOE COUNTY

Peavine district.—The Fravel claim was operated under lease during the early months of 1936, and 60 feet of shaft sinking were done.

White Horse district.—A number of small operations in 1936 were reported in the White Horse district.

WHITE PINE COUNTY

Cherry Creek district.—Old tailings carrying a little gold and silver were shipped from the Cherry Creek district in 1936 to the McGill smelter. A long drainage tunnel was driven by the Nevada Standard Mining Co. to open up a section of the district.

Duck Creek district.—Copper ore was shipped in 1936 from the property of the Success Mining Co. which was operated by a lessee. Lead ore was shipped from the Carbonate Lead mine for smelting; 190 feet of development work were done at the property.

Osceola district.—The production in 1936 of considerable placer gold was reported from the Osceola district.

Piermont district.—Piermont Mines, Inc., ceased operations on its Piermont mine in May 1936 and a lessee took over the property on July 1. More than 1,500 feet of development work were reported, and concentrates carrying high silver content were shipped.

Robinson district.—The Nevada Consolidated Copper Corporation, an operating subsidiary of the Kennecott Copper Corporation, working the Ruth mine at Ruth and its great open pit at Copper Flat, was by far the largest industrial company in Nevada. In addition to its mining activities this company operated the McGill copper smelter, the only smelter in the State. Its flotation concentrator, also at McGill, has a full capacity of 15,000 tons daily. Not only was this company the largest producer of copper in 1936 but it also led all other mines of the State in production of gold during the year. The Lane City and the Phoenix Midnite groups of the Consolidated Coppermines Corporation were operated exclusively by lessess during the year; a large quantity of ore, valued chiefly for its gold content but containing a substantial quantity of silver, was shipped to the McGill smelter. A substantial output was also reported from the Manganese mining claims, and a smaller output from a number of smaller producers.

White Pine district.—A number of operations in 1936 were reported in the White Pine district, including the treatment of Smokey Mill tailings in a 10-ton cyanide plant.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEW MEXICO

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

The total production of gold, silver, copper, lead, and zinc from New Mexico ores and gravels in 1936, in terms of recovered and estimated recoverable metals, was 33,037 fine ounces of gold, 1,163,255 fine ounces of silver, 6,332,000 pounds of copper, 13,252,000 pounds of lead, and 41,336,000 pounds of zinc. This output compares with a production in 1935 of 33,435 ounces of gold, 1,061,902 ounces of silver, 4,505,000 pounds of copper, 14,578,000 pounds of lead, and 44,252,000 pounds of zinc and shows increases of 101,353 ounces in silver and 1,827,000 pounds in copper and decreases of 398 ounces in gold, 1,326,000 pounds in lead, and 2,916,000 pounds in zinc. There were 136 lode mines and 169 placers producing in 1936, a decrease of 14 lode mines and 65 placers from 1935.

The total recorded production of gold, silver, copper, lead, and zinc (in terms of recovered metals) in New Mexico from 1848 to 1936, inclusive, compiled by F. C. Blocksom under direction of Chas. W. Henderson, has been 1,963,792 fine ounces of gold, 58,665,916 fine ounces of silver, 1,550,967,473 pounds of copper, 438,681,385 pounds of lead, and 928,769,394 pounds of zinc.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the prices given in the table that follows. Gold in 1932 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1837, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95 per ounce, the yearly average weighted United States Government price[1]; and in

[1] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25-28.

1935 and 1936 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1932 and 1933 is the average New York price for bar silver; in 1934, the Treasury buying price ($0.64646464+ per ounce) for newly mined silver; and in 1935 and 1936, the yearly average weighted Treasury buying price for newly mined silver. The copper, lead, and zinc prices are weighted yearly averages of all grades of primary metal sold by producers.

Prices of gold, silver, copper, lead, and zinc, 1932–36

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[1] $20.67+	$0.282	$0.063	$0.030	$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35 00	.7745	.092	.046	.050

[1] $20.671835. [2] $0.64646464

Mine production of gold, silver, copper, lead, and zinc in New Mexico, 1932–36, in terms of recovered metals

Year	Mines producing: Lode	Mines producing: Placer	Mines producing: Total	Ore (short tons)	Gold (lode and placer): Fine ounces	Gold (lode and placer): Value	Silver (lode and placer): Fine ounces	Silver (lode and placer): Value
1932	87	378	465	1,464,718	23,208.05	$479,753	1,142,351	$322,143
1933	92	302	394	1,475,839	26,474.09	676,678	1,181,580	413,553
1934	153	328	481	1,397,709	27,307.01	954,380	1,061,775	686,400
1935	150	234	384	440,799	33,435.00	1,170,225	1,061,902	763,242
1936	136	169	305	514,966	33,037.00	1,156,295	1,163,255	900,941

Year	Copper: Pounds	Copper: Value	Lead: Pounds	Lead: Value	Zinc: Pounds	Zinc: Value	Total value
1932	28,419,000	$1,790,397	20,227,000	$606,810	51,186,000	$1,535,580	$4,734,683
1933	26,947,000	1,724,608	22,086,000	817,182	61,848,000	2,597,616	6,229,637
1934	23,630,000	1,890,400	18,729,000	692,973	53,043,000	2,280,849	6,505,002
1935	4,505,000	373,915	14,578,000	583,120	44,252,000	1,947,088	4,837,590
1936	6,332,000	582,544	13,252,000	609,592	41,336,000	2,066,800	5,316,172

Gold and silver produced at placer mines in New Mexico, 1932–36, in terms of recovered metals

Year	Gold: Fine ounces	Gold: Value	Silver: Fine ounces	Silver: Value	Total value	Year	Gold: Fine ounces	Gold: Value	Silver: Fine ounces	Silver: Value	Total value
1932	1,270.28	$26,259	181	$51	$26,310	1935	3,554.40	$124,404	302	$217	$124,621
1933	1,399.15	35,762	160	56	35,818	1936	3,378.00	118,230	235	182	118,412
1934	2,587.64	90,438	212	137	90,575						

Gold.—The mine production of recoverable gold in New Mexico was 33,037 fine ounces valued at $1,156,295 in 1936, compared with 33,435 ounces valued at $1,170,225 in 1935. San Miguel County (Pecos mine) produced 34.93 percent of the total in 1936, Catron 24.44 percent, Sierra (chiefly from placers) 13.62 percent, and Colfax 9.32 percent.

The largest increases over 1935 were 1,261.51 ounces in Socorro County, 1,127.43 ounces in Catron, and 919.97 ounces in Sierra; the largest decreases were 3,275.66 ounces in San Miguel County and 906.43 ounces in Grant. Lead-zinc ore yielded 34.93 percent of the total gold; dry and siliceous ore 49.40 percent; copper, copper-lead, copper-lead-zinc, and lead ores 5.45 percent; and placers 10.22 percent.

Silver.—The mine production of recoverable silver in New Mexico amounted to 1,163,255 fine ounces valued at $900,941 in 1936 compared with 1,061,902 ounces valued at $763,242 in 1935. Grant County produced 38.21 percent of the total in 1936, chiefly from the Ground Hog and San Jose mines in the Central district, with most of the remainder from the Steeple Rock district; Catron County 31.36 percent, all from the Mogollon district; and San Miguel County 25.83 percent, all from lead-zinc ore of the Pecos mine in the Willow Creek district. Lead-zinc and copper-lead-zinc ores from Grant and San Miguel Counties yielded 50.77 percent of the total silver; dry and siliceous ore, chiefly from Catron and Grant Counties, 39.48 percent; and copper, copper-lead, and lead ores 9.73 percent. The quantity recovered from placers was negligible.

Copper.—The mine production of recoverable copper in New Mexico totaled 6,332,000 pounds valued at $582,544 in 1936 compared with 4,505,000 pounds valued at $373,915 in 1935. Chino Mines of the Nevada Consolidated Copper Corporation, which from 1848, and particularly from 1910, has produced the bulk of the State output of copper, was closed in October 1934 and remained idle until January 1937. During this period of idleness at Chino Mines most of the copper produced in the State was recovered in concentrates from copper-lead-zinc and lead-zinc ores of the Ground Hog and San Jose mines, Grant County, and lead-zinc ore of the Pecos mine, San Miguel County. In 1936 copper-lead-zinc and lead-zinc ores yielded 61.53 percent of the total copper, copper and copper-lead ores 35.86 percent, and other types of ore 2.61 percent.

Lead.—The mine production of recoverable lead in New Mexico was 13,252,000 pounds valued at $609,592 in 1936 compared with 14,578,000 pounds valued at $583,120 in 1935. The chief lead-producing districts in 1936 were the Willow Creek, San Miguel County; Central, Grant County; and Magdalena, Socorro County. Lead-zinc and copper-lead-zinc ores yielded 90.82 percent of the total lead.

Zinc.—The mine production of recoverable zinc in New Mexico amounted to 41,336,000 pounds valued at $2,066,800 in 1936 compared with 44,252,000 pounds valued at $1,947,088 in 1935. The zinc-producing districts in 1936, in order, were the Central in Grant County, Willow Creek in San Miguel County, Magdalena in Socorro County, and Pinos Altos in Grant County. The output from the Magdalena district was contained in zinc-lead sulphide ore shipped to the zinc-lead pigment plant at Coffeyville, Kans. Production from the other districts was 45,528 tons of zinc concentrates containing, as shipped, 1,216.60 ounces of gold, 106,700 ounces of silver, 834,809 pounds of copper, 921,194 pounds of lead, and 48,960,110 pounds of zinc; the average zinc content of the concentrates was 53.77 percent.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1936, by counties, in terms of recovered metals

County	Mines producing			Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Total		Fine ounces	Value	Fine ounces	Value
Catron	5		5	79,288	8,073.60	$282,576	364,816	$282,550
Colfax	5	13	18	15,660	3,079.60	107,786	2,528	1,958
Dona Ana	1		1	2	.08	3	22	17
Grant	57	16	73	224,962	1,930.00	67,550	444,475	344,246
Hidalgo	26	1	27	21,585	1,385.60	48,496	32,417	25,107
Lincoln	4	56	60	299	426.72	14,935	594	460
Luna	4		4	76	4.20	147	745	577
Otero		10	10		94.20	3,297	9	7
Rio Arriba		2	2		2.80	98		
San Miguel	1		1	150,932	11,541.00	403,935	300,514	232,748
Santa Fe	4	31	35	154	182.80	6,398	62	48
Sierra	20	40	60	1,464	4,498.60	157,451	10,940	8,473
Socorro	6		6	20,018	1,812.40	63,434	5,791	4,485
Taos	2		2	501	5.40	189	337	261
Torrance	1		1	25			5	4
	136	169	305	514,966	33,037.00	1,156,295	1,163,255	900,941
Total, 1935	150	234	384	440,799	33,435.00	1,170,225	1,061,902	763,242

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Catron	5,000	$430	1,000	$46			$565,632
Colfax	105,200	9,678					119,422
Dona Ana			300	14			34
Grant	4,451,300	409,520	5,418,000	249,228	21,436,000	$1,071,800	2,142,344
Hidalgo	817,000	75,164	91,000	4,186			152,953
Lincoln	250	23	9,800	451			15,869
Luna	250	23	16,700	768			1,515
Otero							3,304
Rio Arriba							98
San Miguel	909,000	83,628	7,491,000	344,586	19,334,000	966,700	2,031,597
Santa Fe	3,500	322					6,768
Sierra	38,000	3,496	12,700	584			170,004
Socorro	1,000	92	211,500	9,729	566,000	28,300	106,040
Taos							450
Torrance	1,500	138					142
	6,332,000	582,544	13,252,000	609,592	41,336,000	2,066,800	5,316,172
Total, 1935	4,505,000	373,915	14,578,000	583,120	44,252,000	1,947,088	4,837,590

Gold and silver produced at lode mines in New Mexico in 1936, by counties, in terms of recovered metals

County	Ore sold or treated	Gold	Silver
	Short tons	*Fine ounces*	*Fine ounces*
Catron	79,288	8,073.60	364,816
Colfax	15,660	2,961.40	2,510
Dona Ana	2	.08	22
Grant	224,962	1,859.60	444,457
Hidalgo	21,585	1,383.00	32,417
Lincoln	299	123.92	572
Luna	76	4.20	745
San Miguel	150,932	11,541.00	300,514
Santa Fe	154	96.60	58
Sierra	1,464	1,797.80	10,776
Socorro	20,018	1,812.40	5,791
Taos	501	5.40	337
Torrance	25		5
	514,966	29,659.00	1,163,020
Total, 1935	440,799	29,880.60	1,061,600

Gold and silver produced at placer mines in New Mexico in 1936, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Drift mining		Dry-land dredges[1]		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Colfax	106.69	16	11.51	2	--------	--------	118.20	18
Grant	70.40	18	--------	--------	--------	--------	70.40	18
Hidalgo	2.60	--------	--------	--------	--------	--------	2.60	--------
Lincoln	240.55	18	21.79	1	40.46	3	302.80	22
Otero	64.31	6	--------	--------	29.89	3	94.20	9
Rio Arriba	2.80	--------	--------	--------	--------	--------	2.80	--------
Santa Fe	86.20	4	--------	--------	--------	--------	86.20	4
Sierra	68.99	4	--------	--------	2,631.81	160	2,700.80	164
	642.54	66	33.30	3	2,702.16	166	3,378.00	235
Total, 1935	899.90	151	--------	--------	2,654.50	151	3,554.40	302

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

MINING INDUSTRY

A heavy loss to the mining industry and to the State of New Mexico in 1935–36 was the continued shut-down of Chino Mines of the Nevada Consolidated Copper Corporation (subsidiary of the Kennecott Copper Corporation), closed in October 1934. However, improved prices for copper in 1936 resulted in the resumption, in January 1937, of open-cut operations at Santa Rita and the operation of several units (with a total capacity of 8,000 tons a day) of the 15,000-ton flotation mill at Hurley. The Kennecott Copper Corporation report for the first quarter of 1937 predicts expansion to capacity production. In 1936 the combined tonnage of lead-zinc (including copper-lead-zinc in 1936) and zinc ores showed little change from 1935 but was 6 percent greater than in 1934. The combined tonnage of dry and siliceous gold, silver, and gold-silver ores in 1936 was 53 percent greater than in 1935 and 120 percent greater than in 1934.

Details of operations of important producers in 1936 are given in the following review by counties and districts.

To continue annual detailed statistics for New Mexico on mine production by classes of ore, methods of recovery of metals, and mining districts, the data for 1935 not available for inclusion in Minerals Yearbook, 1936, are supplied in this chapter.

ORE CLASSIFICATION

Ore sold or treated in New Mexico, 1935–36, with content in terms of recovered metals

Source	Ore	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	16, 772	6, 823. 14	19, 908	64, 570	91, 250	
Dry and siliceous gold and silver ore	62, 226	7, 518. 33	305, 024	21, 410	6, 780	
Dry and siliceous silver ore	698	17. 16	12, 143	860	5, 850	
	79, 696	14, 358. 63	337, 075	86, 840	103, 880	
Copper ore	3, 275	481 80	13, 444	521, 500	116, 800	
Copper-lead ore	277	4. 70	6. 215	20, 250	175, 000	
Lead ore	493	107. 01	3, 383	4, 410	125, 320	
Lead-zinc and zinc ores	357, 058	14, 928. 46	701, 483	3, 872, 000	14, 057, 000	44, 252, 000
	361, 103	15, 521. 97	724, 525	4, 418, 160	14, 474, 120	44, 252, 000
Total, lode mines	440, 799	29, 880. 60	1, 061, 600	4, 505, 000	14, 578, 000	44, 252, 000
Total, placers		3, 554 40	302			
	440, 799	33, 435. 00	1, 061, 902	4, 505, 000	14, 578, 000	44, 252, 000
1936						
Dry and siliceous gold ore	34, 215	6, 927. 37	11, 071	145, 108	9, 300	
Dry and siliceous gold and silver ore	86, 810	9, 374. 78	436, 180	13, 880	10, 400	
Dry and siliceous silver ore	1, 071	16. 91	11, 973	3, 453	2, 600	
	122, 096	16, 319. 06	459, 224	162, 441	22, 300	
Copper ore	31, 056	1, 601. 56	94, 392	2, 209, 219	564, 770	
Copper-lead ore	950	6. 70	13, 401	61, 240	486, 670	
Copper-lead-zinc ore [1]	72, 954	132. 30	290, 014	2, 987, 000	4, 369, 000	5, 628, 000
Lead ore	450	58. 38	5, 363	3, 100	142, 260	
Lead-zinc and zinc ores [1]	287, 460	11, 541. 00	300, 626	909, 000	7, 667, 000	35, 708, 000
	392, 870	13, 339. 94	703, 796	6, 169, 559	13, 229, 700	41, 336, 000
Total, lode mines	514, 966	29, 659. 00	1, 163, 020	6, 332, 000	13, 252, 000	41, 336, 000
Total, placers		3, 378. 00	235			
	514, 966	33, 037. 00	1, 163, 255	6, 332, 000	13, 252, 000	41, 336, 000

[1] Ore from 2 properties, classed as lead-zinc in 1935, became copper-lead-zinc ore in 1936.

METALLURGIC INDUSTRY

All markets for New Mexico ore and concentrates are outside the State. In 1936 copper ore and concentrates and dry and siliceous ores and concentrates were sold to the American Smelting & Refining Co. copper plant at El Paso, Tex.; to the Copper Queen copper smelter at Douglas, Ariz.; to the International Smelting Co. copper smelter at Miami, Ariz.; and to the Magma Copper Co. copper smelter at Superior, Ariz. Lead ore and concentrates were sold to the American Smelting & Refining Co. lead plant at El Paso, Tex. Zinc concentrates were shipped to the American Smelting & Refining Co. natural-gas retort plant at Amarillo, Tex.; to the Illinois Zinc Co. retort plant at Peru, Ill. (moved to Dumas, Tex., during the year); to the American Metal Co. producer-gas retort plant at Langeloth, Pa.; and to the American Metal Co. natural-gas retort plant at Blackwell, Okla. Zinc-lead sulphide ore was shipped to the Ozark Smelting & Mining Co. zinc-lead pigment plant at Coffeyville, Kans. Small lots of gold ore were sold to the Golden Cycle mill at Colorado Springs, Colo. Three mills in New Mexico treating straight gold and gold-silver ores used the cyanide process for the recovery of metals in 1936.

Selective flotation was used at all important concentration mills in New Mexico in both 1935 and 1936. The following table gives the names of the active flotation mills and the location, county, rated capacity, type of ore treated, and type of concentrate produced.

Flotation mills in New Mexico active in 1935 and 1936

Name of company or mill	Location of mill	County	Rated capacity (short tons per 24 hours)	Type of ore treated	Type of concentrate produced
Aztec Mines	Mount Baldy (Ute Creek).	Colfax	100	Gold-silver-copper	Gold-silver-copper.
Banner Mining Co.[1]	Lordsburg (6 miles south of).	Hidalgo	200	Copper-gold-silver	Copper-gold-silver.
Combination (Black Hawk).	Hanover	Grant	250	Zinc-lead-copper-silver.	Zinc, lead-silver, copper-silver.
Mogollon Consolidated Mines Co.	Mogollon	Catron	150	Gold-silver	Gold-silver.
Molybdenum Corporation of America.	Red River and Sulphur Creek	Taos	40	Molybdenum	Molybdenum.
Pecos (American Metal Co.).	Alamitos Canyon	San Miguel	600	Zinc-lead-copper-gold-silver.	Zinc, lead-copper-gold-silver.
Peru Mining Co	Wemple	Luna	500	Zinc	Zinc.
Springtime Mining Co.	San Mateo Mountains.	Socorro	40	Gold-silver	Gold-silver.

[1] 1936 only.

Mine production of metals in New Mexico, 1935–36, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore amalgamated	4,842	846.02	170			
Ore cyanided	50,513	6,426.46	199,509			
Concentrates cyanided	242	812.00	58			
Concentrates smelted	[1] 73,402	16,602.84	778,847	3,875,100	13,813,000	43,551,000
Ore smelted	15,440	5,193.28	83,016	629,900	765,000	701,000
Placer		3,554.40	302			
		33,435.00	1,061,902	4,505,000	14,578,000	44,252,000
1936						
Ore amalgamated	338	341.71	96			
Ore cyanided	54,336	6,836.15	191,820			
Concentrates smelted	[2] 69,907	18,710.04	798,063	4,806,120	11,923,830	40,770,000
Ore smelted	20,841	3,771.10	173,041	1,525,880	1,328,170	566,000
Placer		3,378.00	235			
		33,037.00	1,163,255	6,332,000	13,252,000	41,336,000

[1] From 370,004 tons of ore treated at concentrating mills and 4,212 tons of ore first amalgamated.
[2] From 439,451 tons of ore treated at concentrating mills and 16,179 tons of ore treated at gold and silver mills equipped for table concentration and cyanidation.

Gross metal content of New Mexico concentrates produced, 1935–36, by classes of concentrates [1]

Class of concentrates	Concentrates produced (dry weight) [1]	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	[1] 175	575.68	4,857	2,806	9	
Dry gold and silver	133	1,098.70	72,507	1,996	2,102	
Copper-lead	25,011	13,854.68	625,691	4,117,366	15,556,512	5,194,292
Zinc	48,083	1,457.22	124,347	904,179	940,003	52,507,216
	[1] 73,402	16,986.28	827,402	5,026,347	16,498,626	57,701,508
1936						
Dry gold	156	278.55	2,827	61		
Dry gold and silver	592	2,748.29	175,086	6,787	1,691	
Copper	2,581	4,008.11	29,158	941,980	103,637	
Copper-lead	21,035	11,111.30	538,844	3,925,590	13,387,792	4,747,971
Lead	15	1.79	352	263	9,722	
Zinc	45,528	1,216.60	106,700	834,809	921,194	48,960,110
	69,907	19,364.64	852,967	5,709,490	14,424,036	53,708,081

[1] Exclusive in 1935 of 242 tons of dry gold concentrates cyanided, containing 897.10 ounces of gold and 88 ounces of silver.

Mine production of metals from New Mexico concentrates, 1935–36, by counties, in terms of recovered metals

County	Ore treated at concentrating mills	Concentrates and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Catron	12,408	133	1,098.70	72,507	1,000	1,000	
Colfax	1,200	[1] 56	168.60	22	2,100		
Grant	169,721	28,786	111.80	268,861	2,645,000	3,489,000	16,807,000
San Miguel	185,380	44,308	14,816.66	432,622	1,227,000	10,323,000	26,744,000
Socorro	1,295	119	407.08	4,835			
	370,004	[1] [2] 73,402	16,602.84	778,847	3,875,100	13,813,000	43,551,000
1936							
Catron	41,125	571	2,707.61	173,311	5,000	1,000	
Colfax	15,519	638	2,748.20	2,468	105,100		
Grant	207,911	33,913	132.30	290,126	2,987,000	4,371,000	21,436,000
Hidalgo	20,996	1,943	1,259.91	26,690	799,200	52,130	
Lincoln	85	15	1.79	352	250	8,700	
San Miguel	150,932	32,650	11,541.00	300,514	909,000	7,491,000	19,334,000
Sierra	209	12	36.28	1,444	570		
Socorro	2,174	[3] 156	278.55	2,827			
Taos	500	9	4.40	331			
	439,451	[3] 69,907	18,710.04	798,063	4,806,120	11,923,830	40,770,000

[1] Exclusive of 242 tons of concentrates cyanided, yielding 812.00 fine ounces of gold and 58 fine ounces of silver.
[2] Includes 33 tons (1 ton from Catron County and 32 tons from Socorro) of concentrates from 4,212 tons of ore treated at gold and silver mills equipped for amalgamation and concentration.
[3] Includes 38 tons of concentrates from 16,179 tons of ore treated at gold and silver mills equipped for table concentration and cyanidation.

Gross metal content of New Mexico crude ore shipped to smelters, 1935–36, by classes of ore

Class of ore	Ore	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold	6,135	3,984.07	14,572	67,967	117,221	
Dry and siliceous gold and silver	2,605	622.73	33,270	21,517	11,579	194
Dry and siliceous silver	698	17.16	12,143	1,412	10,790	374
Copper	3,275	481.80	13,444	543,528	234,252	1,243
Copper-lead	277	4.70	6,215	22,316	194,452	
Lead	493	107.01	3,383	6,689	140,153	
Lead-zinc	1,957				350,280	844,560
	15,440	5,217.47	83,027	663,429	1,058,727	846,371
1936						
Dry and siliceous gold	2,177	2,202.09	5,825	41,939	18,120	
Dry and siliceous gold and silver	4,647	1,147.16	69,129	8,830	18,266	
Dry and siliceous silver	1,071	16.91	11,973	3,691	5,245	
Copper	10,060	341.66	67,710	1,469,003	1,024,482	1,356,460
Copper-lead	950	6.70	13,401	87,056	540,731	123,200
Lead	365	56.59	5,011	4,108	148,417	
Lead-zinc	1,571				248,012	682,097
	20,841	3,771.11	173,049	1,614,627	2,003,273	2,161,757

Mine production of metals from New Mexico crude ore shipped to smelters, 1935–36, by counties, in terms of recovered metals

County	Ore	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Catron	16	50.57	2,418			
Colfax	40	112.15	28	1,900		
Dona Ana	13		736		200	
Grant	8,379	2,498.73	56,003	503,000	387,700	
Hidalgo	3,075	992.86	16,178	89,000	47,500	
Lincoln	675	279.50	340	2,000	17,900	
Luna	54	6.20	380		7,400	
Rio Arriba	5	1.30	5		100	
Sandoval	159	20.20	1,575		7,800	
Santa Fe	124	54.20	174	11,000	100	
Sierra	731	1,085.22	4,202	22,000	19,100	
Socorro	2,169	92.35	977	1,000	277,200	701,000
	15,440	5,193.28	83,016	629,900	765,000	701,000
1936						
Catron	8	31.15	2,330			
Colfax	13	21.70	17	100		
Dona Ana	2	.08	22		300	
Grant	17,046	1,694.58	154,319	1,464,300	1,047,000	
Hidalgo	589	123.09	5,727	17,800	38,870	
Lincoln	19	12.31	168		1,100	
Luna	76	4.20	745	250	16,700	
Santa Fe	144	88.33	57	3,500		
Sierra	1,255	1,761.52	9,332	37,430	12,700	
Socorro	1,664	34.14	319	1,000	211,500	566,000
Torrance	25		5	1,500		
	20,841	3,771.10	173,041	1,525,880	1,328,170	566,000

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in New Mexico, 1935–36, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
1935			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Catron County: Mogollon	6		59,637	6,946.17		6,946.17	274,172		274,172	1,000	1,000		$440,300
Colfax County: Mount Baldy	5	8	5,323	2,143.77	173.11	2,316.88	267	25	292	4,000			81,633
Dona Ana County: Organ	1		13				736		736		200		537
Grant County:													
Burro Mountain	3		758	81.45		81.45	4,615		4,615	13,700	950		7,343
Central	11	1	172,561	252.89	6.09	258.98	286,094	3	286,097	3,094,650	3,781,150	16,807,000	1,362,306
Chloride Flat	1		24	.40		.40	534		534		200		406
Gold Hill [1]	2		55	14.08		14.08	21		21				508
Pinos Altos	19	50	3,860	1,895.34	130.94	2,026.28	14,180	78	14,258	37,450	94,400		88,052
Steeple Rock	5		1,377	406.78		406.78	19,470		19,470	2,200			28,414
White Signal		1			48.46	48.46		8	8				1,702
Hidalgo County:													
Eureka	6		1,101	472.11		472.11	1,770		1,770	10,000	10,650		19,052
Gold Hill [1]	4		41	56.55		56.55	93		93	400	1,100		2,123
Lordsburg	33		1,658	439.97		439.97	11,370		11,370	78,000	28,100		31,169
San Simon	3		275	24.23		24.23	2,945		2,945	600	7,650		3,321
Lincoln County:													
Jicarilla		63			309.09	309.09		21	21				10,833
Nogal	2	8	132	157.06	24.60	181.66	74	7	81		600		6,440
Red Cloud	1		61	.40		.40	185		185	2,000	17,300		1,005
White Oaks	3		770	402.25		402.25	168		168				14,200
Luna County:													
Tres Hermanas	1		14	.60		.60	121		121		2,500		208
Victorio	1		40	5.60		5.60	259		259		4,900		578
Otero County: Orogrande		8			258.69	258.69		18	18				9,067
Rio Arriba County: Headstone	1	4	8	3.40	6.51	9.91	7		7		100		356
Sandoval County: Cochita	2		159	20.20		20.20	1,575		1,575		7,800		2,151
San Miguel County: Willow Creek	1		185,380	14,816.66		14,816.66	432,622		432,622	1,227,000	10,323,000	26,744,000	2,521,027
Santa Fe County:													
Los Cerrillos	1	16	9	32.08	24.97	57.05	14		14		100		2,011
San Pedro	4	40	135	58.52	85.43	143.95	164	4	168	11,000			6,072
Sierra County:													
Chloride	4		4	1.11		1.11	100		100		300		123
Kingston	1		6	.09		.09	106		106				79
Lake Valley	1		56				1,550		1,550		400		1,130
Las Animas	18	10	666	1,098.00	1,761.37	2,859.37	2,450	111	2,561	22,000	18,400		104,481
Pittsburg		21			718.06	718.06		24	24				25,149

Socorro County:													
Magdalena	5		2,115	60.80		60.80	910		910	1,000	262,900	701,000	44,225
Rosedale	1		2,972	158.14		158.14	147		147				5,641
Salinas Peak	1		19				25		25		14,300		590
San Mateo Mountains	2		1,330	311.55		311.55	4,842		4,842				14,384
Silver Hills	1		240	20.40		20.40	14		14				724
Taos County: Rio Grande River		4			7.08	7.08		3	3				250
Total New Mexico	150	234	440,799	29,880.60	3,554.40	33,435.00	1,061,600	302	1,061,902	4,505,000	14,578,000	44,252,000	4,837,590
1936													
Catron County: Mogollon	5		79,288	8,073.60		8,073.60	364,816		364,816	5,000	1,000		565,632
Colfax County: Mount Baldy	5	13	15,660	2,961.40	118.20	3,079.60	2,510	18	2,528	105,200			119,422
Dona Ana County: Organ	1		2	.08		.08	22		22		300		34
Grant County:													
Burro Mountain	4		133	25.89		25.89	2,399		2,399	150	260		2,790
Camp Fleming	4		382	50.37		50.37	5,698		5,698	50	240		6,192
Central	11	3	218,468	178.83	7.23	186.06	369,140	1	369,141	4,426,500	5,378,000	21,412,000	2,017,638
Chloride Flat	2		578				4,567		4,567	400	1,300		3,634
Gold Hill [1]	3		175	24.40		24.40	1,618		1,618	100			2,116
Lone Mountain	3		12	1.00		1.00	452		452				385
Pinos Altos	19	11	1,437	729.11	58.51	787.62	6,408	17	6,425	18,500	37,900	24,000	37,188
Steeple Rock	10		3,777	849.60		849.60	54,173		54,173	5,600	300		72,222
White Signal	1	2	(2)	.40	4.66	5.06	2		2				179
Hidalgo County:													
Eureka	6	1	134	42.85	2.60	45.45	785		785	450	36,800		3,933
Gold Hill [1]	3		16	10.55		10.55	40		40	250	700		455
Lordsburg	15		21,279	1,306.20		1,306.20	28,612		28,612	816,150	52,900		145,396
San Simon	2		156	23.40		23.40	2,980		2,980	150	600		3,169
Lincoln County:													
Jicarilla		54			289.40	289.40		20	20				10,144
Nogal	2	1	214	122.12	2.20	124.32	213	1	214		1,100		4,568
White Oaks	2	1	85	1.80	11.20	13.00	359	1	360	250	8,700		1,157
Luna County:													
Cooks Peak	1		3				7		7		1,000		51
Florida Mountains	1		19	.20		.20	80		80	100	4,200		271
Tres Hermanas	1		54	4.00		4.00	647		647	150	11,400		1,179
Victorio	1		(3)				11		11		100		14
Otero County: Orogrande		10			94.20	94.20		9	9				3,304
Rio Arriba County: Headstone		2			2.80	2.80							98
San Miguel County: Willow Creek	1		150,932	11,541.00		11,541.00	300,514		300,514	909,000	7,491,000	19,334,000	2,031,597
Santa Fe County:													
Ortiz Mountains	2		110	82.20		82.20	13		13	370			2,921
San Pedro	2	31	44	14.40	86.20	100.60	45	4	49	3,130			3,847

[1] District lies in both Grant and Hidalgo Counties.
[2] 850 pounds.
[3] 375 pounds.

Mine production of gold, silver, copper, lead, and zinc in New Mexico, 1935-36, by counties and districts, in terms of recovered metals—Con.

County and district	Mines producing		Ore sold or treated	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
1936—Continued			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Sierra County:													
Chloride	5		245	151.26		151.26	3,685		3,685	1,800			$8,314
Hermosa	1		10	.20		.20	342		342	150	6,100		567
Kingston	2		166	1.88		1.88	1,818		1,818	950	5,400		1,809
Lake Valley	1		60	6.60		6.60	488		488	120	1,200		675
Las Animas	11	25	983	1,637.86	1,620.14	3,258.00	4,443	128	4,571	34,980			120,788
Pittsburg		15			1,080.66	1,080.66		36	36				37,851
Socorro County:													
Magdalena	3		1,664	34.14		34.14	319		319	1,000	211,500	566,000	39,563
Rosedale	1		16,179	1,631.35		1,631.35	2,682		2,682				59,174
San Mateo Mountains	2		2,175	146.91		146.91	2,790		2,790				7,303
Taos County: Red River	2		501	5.40		5.40	337		337				450
Torrance County: Carocito	1		25				5		5	1,500			142
Total New Mexico	136	169	514,966	29,659.00	3,378.00	33,037.00	1,163,020	235	1,163,255	6,332,000	13,252,000	41,336,000	5,316,172

CATRON COUNTY

Mogollon district.—The Mogollon district, which produced only dry and siliceous gold-silver ore, ranked second among New Mexico districts in output of both gold and silver in 1936. The largest producer of both metals was the Black Hawk Consolidated Mines Co., which operated the Little Fanney cyanide mill at Mogollon at the rate of approximately 100 tons daily for 365 days on ore from the Little Fanney, Champion, and Consolidated claims of the Little Fanney and Johnson groups. The Mogollon Consolidated Mines Co. treated ore from its Deadwood-Last Chance group by flotation concentration in the 150-ton mill which the company erected and placed in operation in 1935; the mill ran throughout 1936. The product was high-grade gold-silver concentrates, containing some copper, which were shipped to the El Paso smelter. At the Queen group the Cooney Mining Co. did 1,000 feet of development in the mine and operated its 50-ton cyanide plant intermittently at reduced capacity from June 15 to December 4. Development work was done at the Ann Arbor property; some ore and dump material were treated during test runs of the mill, resulting in the shipment of a few tons of high-grade gold-silver concentrates. Several small lots of high-grade gold-silver ore were shipped to the El Paso smelter from the Bearup property.

COLFAX COUNTY

Mount Baldy district (Baldy, Elizabethtown, Eagle Nest).—Aztec Mines, lessee of the Aztec Mines property of the Maxwell Land Grant Co. at the head of Ute Creek, operated the mine and flotation-concentration mill continuously in 1936. When flotation equipment was installed in October 1935 the mill had a capacity of 36 tons per 24 hours, but new equipment added in 1936 raised its capacity to 100 tons; the daily average treated for 365 days in 1936 was 42½ tons. The product was gold-silver-copper concentrates which were shipped to the El Paso smelter. At the Montezuma mine, also owned by the Maxwell Land Grant Co., a lessee treated 60 tons (wet weight) of ore in the small amalgamation mill at the mine and shipped some ore to the Golden Cycle mill at Colorado Springs, Colo. The owner of the Red Bandana mine produced amalgamation bullion from ore treated in a 20-ton Huntington mill with copper plates and shipped a few small lots of ore to the Golden Cycle mill. A 2-ton lot of ore was shipped from the Gold Dollar claim, and a small lot of bullion was produced at the Sulphide. A 50-ton stamp amalgamation-table concentration mill was erected at the French Henry property, and development work was done in the mine. Drift mining and hydraulicking at the Ute Creek placers and sluicing operations on South Ponil, Ute, and Willow Creeks yielded the remainder of the output from the district.

DONA ANA COUNTY

Organ district.—A 2-ton lot of lead-silver ore was shipped to the El Paso smelter from the Silver King claim, on which the owner sank 35 feet of shaft in 1936.

153336—37——31

GRANT COUNTY

Burro Mountain district (*Tyrone*).—Early in 1936 lessees shipped three cars of dry silver ore containing a little gold, lead, and copper from the Contact group to the El Paso smelter. Other output from the Burro Mountain district in 1936 comprised small lots of gold ore from the Big Chief and Shamrock claims and a small lot of silver ore from the Bismuth.

Camp Fleming district (*Silver City*).—Most of the metal production from the Camp Fleming district in 1936 was recovered from gold-silver ore shipped at intervals throughout the year by a lessee of the old Old Man mine at the south end of Treasure Mountain about 5 miles northwest of Silver City. Part of the ore was shipped direct to the El Paso smelter; part was sold to Ira L. Wright, of Silver City, who reshipped it to the smelter. This mine was reopened in 1935 and a small quantity of ore was shipped in that year, but the production was included in the figures for the Central district. A few tons of ore were shipped in 1936 from the Silver King, Pay Day, and one other property in the Camp Fleming district.

Central district (*Bayard, Fierro, Georgetown, Hanover, Santa Rita*).—In 1936 the Black Hawk Consolidated Mines Co. continued to operate its 250-ton selective flotation mill 1 mile south of Hanover on custom zinc-lead-copper-silver sulphide ore from the Ground Hog and San Jose properties of the Asarco Mining Co. and on company ore of a similar type from the Combination mine. The mill feed averaged 4.64 ounces of silver to the ton, 2.70 percent copper (wet assay), 4.32 percent lead (wet assay), and 7.52 percent zinc. The mill was operated 360 days at a daily average of 203 tons. Part of the ore mined at the Ground Hog and San Jose properties was of direct-smelting grade and was shipped crude to the El Paso smelter. Operated as a unit, these two mines yielded the bulk of the silver, copper, and lead produced in Grant County in 1936 and were substantial producers of zinc. The Peru Mining Co. increased the output of lead-free zinc sulphide ore from its Pewabic mine at Hanover. The ore is shipped 60 miles by railroad to the company 500-ton flotation mill (mentioned also under Luna County) at Deming for treatment. Several hundred tons of ore produced during development at the Peerless group at Central were run through the Combination mill to test the ore. Smelting ore obtained from various other mines and dumps was shipped from the district. Chino Mines of the Nevada Consolidated Copper Corporation at Santa Rita and its 15,000-ton flotation mill at Hurley remained idle in 1936 but were reopened in January 1937. Preparations were being made in April 1937 to reopen the zinc mine and 300-ton flotation mill of the Empire Zinc Co. at Hanover, closed since April 1, 1931. A small quantity of placer gold, reported to have been mined 3 miles east of Silver City by individuals, was sold to a bullion buyer at El Paso, Tex., in 1936.

Chloride Flat district (*Silver City*).—Development work was carried on continuously for 11 months in 1936 at the Bremen "76" group of mines, and 12 cars of dry silver ore were shipped to the El Paso smelter. Two tons of silver-lead ore were shipped to the smelter by a lessee at another property in the Chloride Flat district.

Gold Hill district (*see also Hidalgo County*).—The owner of the Silver Dollar claim operated the mine intermittently throughout 1936 and produced most of the ore shipped from the Gold Hill district (Grant

County) during the year. Small lots of gold ore were shipped from the Gold Bullion and one other prospect.

Lone Mountain district.—Small lots of dry silver ore were shipped from the Bisby, Ben Hur, and Rocky Mountain claims in 1936. At the Bisby group Barron & Gleason did some exploration work, including the sinking of a 50-foot shaft. In May the company started construction work on a mill in Maud Canyon 3 miles east of Silver City, to be used for treating ore from the Bisby group and custom ores. The mill was not completed in 1936.

Pinos Altos district.—Nearly all the ore produced in the Pinos Altos district in 1936 was shipped crude to the El Paso smelter. Producing mines and dumps included the Baltimore, Bonanza No. 3, Campo Santo, Cleveland, Gillette-Manhattan, Golden Giant, Hazard, North and South, and Wild Bill. A car of zinc concentrates produced at the Metcalf mill at Pinos Altos during experimental milling of ore reported to have come from the Silver Hill mine was shipped to the Amarillo (Tex.) zinc smelter early in 1936. The quantity of placer gold produced by individuals engaged in panning, rocking, and sluicing near Pinos Altos was smaller in 1936 than in 1935.

Steeple Rock district.—All the ore mined in the Steeple Rock district in 1936 was dry and siliceous gold-silver ore containing a small percentage of copper and was shipped crude to copper smelters at Miami, Magma, and Douglas, Ariz., and El Paso, Tex. The largest producer of metals was the East Camp group, followed in order by the Norman King and Billali groups. These three mines yielded 83 percent of the total output of gold in the district and 86 percent of the silver. The remainder came from the Alabama (old stock pile shipped), Carlisle, Homestake, Jim Crow, and Summit mines and two prospects.

White Signal district.—A small lot of gold ore was shipped from the Combination claim in the White Signal district in 1936, and a little gold was recovered by sluicing at two small placers.

HIDALGO COUNTY

Eureka district (Hachita).—Ore produced in the Hachita district in 1936 was shipped to the El Paso smelter or was sold in small lots to ore buyers at Douglas, Ariz. A car of sorted ore from the Hardscrabble dump yielded most of the gold; lead-silver ore from the Lead Queen, Mariposa, and Wilcox properties yielded most of the other metals. A little placer gold recovered from the Bader placer was sold to the Denver Mint early in 1936.

Gold Hill district (see also Grant County).—Small lots of smelting ore were shipped from three prospects in the Gold Hill district in 1936.

Lordsburg district (including Pyramid and Virginia or Shakespeare districts).—In 1936 the Banner Mining Co., lessee of the Bonney Mine group, did considerable development work in the mine and erected a 200-ton mill to treat the siliceous copper-gold-silver ore of the group by flotation concentration. The mill began operations in August and ran continuously the remainder of the year but not at full capacity the entire period. The product was copper-gold-silver concentrates which were sold to the El Paso smelter. Other producers in the district shipped their ore to smelters in Texas and Arizona or sold it in small lots to buyers of ore at Silver City, N. Mex., and Douglas, Ariz. Among the producing mines and prospects were the Atwood group, Battleship, and Misers Chest, all worked by lessees.

San Simon district (*Steins*).—The Hattie Lee (old Beck) mine was operated by lessees from January 14 to November 1 and was the only producer of more than a car of ore in the San Simon district in 1936. Silver was the metal of chief value in the ore, which was shipped crude to smelters. The other output from the district comprised silver-copper ore from the Guadalupe claim.

LINCOLN COUNTY

Jicarilla district.—Most of the output from the Jicarilla district in 1936 was small lots of placer gold produced in the Jicarilla Mountains southeast of Ancho by individuals and prospectors who sold the gold to merchants at Ancho and Carrizozo. A power shovel and special sluicing installation were operated from November 1 to December 31 at the Ancho and Rico claims and recovered nearly all the rest of the output from the district. William Little moved a power shovel and Ainlay-bowl recovery plant to the Turner-Moody group 1 mile east of Jicarilla and made tests on the ground during September and October.

Nogal district.—The Helen Rae mine was operated intermittently on a small scale in 1936. Bullion was recovered in a small amalgamation plant at the mine, and some ore was shipped to the El Paso smelter. Late in the year equipment comprising a 75-ton ball mill and amalgamation plates was installed at the Great Western property, from which a small lot of bullion was shipped to the Denver Mint. Some development work was done at the Silver Plume and Bonita groups. A little placer gold was recovered on Day Gulch south of Nogal.

White Oaks district.—Test runs, for a short period early in 1936, of the flotation mill at the property of the Lincoln County Mining & Milling Co. resulted in the shipment of a few truckloads of lead-silver concentrates to the El Paso smelter. A small lot of ore was shipped from a prospect in the White Oaks district, and some development work was done at the Crown Gold Silver group. M. F. Hutter recovered placer gold by use of a rocker on Baxter Gulch.

LUNA COUNTY

Cooks Peak district.—A small lot of lead-silver ore was shipped from the "85"-Ethel group in 1936.

Deming.—The 500-ton selective flotation mill of the Peru Mining Co. at Wemple, near Deming, was operated 299 days in 1936 at an average daily rate of 450 tons on lead-free zinc sulphide ore from the company's Pewabic mine at Hanover, Grant County.

Florida Mountains district.—Lessees at the Chavez-Reinhard property shipped a few lots of lead-silver ore in 1936.

Tres Hermanas district (*Columbus*).—A car of lead-silver-gold ore was shipped from Columbus to the El Paso smelter in 1936.

Victorio district.—A prospector did 10 feet of development work at the Silver Branch claim in 1936 and produced a small lot of lead-silver ore which he sold to an ore buyer at Silver City.

OTERO COUNTY

Orogrande district.—The output from Otero County in 1936 was placer gold from the Orogrande district, most of which was produced

from sluicing operations at small placers. A special placer machine was operated intermittently after July at the Little Joe and Cotton Top placers and recovered some gold.

RIO ARRIBA COUNTY

Headstone district.—Small sluicing operations on Eureka Gulch yielded a little placer gold in 1936.

SAN MIGUEL COUNTY

Willow Creek district (Terrero).—The Pecos mine of the American Metal Co. on Willow Creek has been the largest single producer of gold, silver, lead, and zinc in New Mexico since it was opened in 1927. Operations were continuous in 1936 except for an interruption caused by a miners' strike during part of February and all of March and April. The ore is transported over a 12-mile aerial tram from the mine to the company selective flotation mill in Alamitos Canyon 6 miles by road from Glorieta station and 4 miles by railroad spur from Fox station on the Atchison, Topeka & Santa Fe Railway. The mill treated an average of 574 tons daily for 263 days in 1936. The heads of ore into the mill in 1936 averaged 0.102 ounce of gold and 3.08 ounces of silver to the ton, 0.67 percent copper (wet assay), 3.55 percent lead (wet assay), 9.58 percent zinc, and 12.33 percent iron. The yield from 150,932 dry tons of ore treated in 1936 was 21,544 tons of zinc concentrates—averaging 0.056 ounce of gold and 3.52 ounces of silver to the ton, 1.12 percent copper (wet assay), 1.01 percent lead (wet assay), 54.06 percent zinc, and 8.11 percent iron—and 11,106 tons of lead-copper concentrates—averaging 0.99 ounce of gold and 24.51 ounces of silver to the ton, 4.35 percent copper (wet assay), 37.47 percent lead (wet assay), 10.13 percent zinc, and 12.53 percent iron.

The Cristino Rivera Mining Co., at its property in sec. 27, T. 18 N., R. 12 E., New Mexico principal meridian, sank 90 feet of shaft from May 12 to December 31, 1936, making the total depth of the shaft 180 feet.

SANTA FE COUNTY

Ortiz Mountains district (Cerrillos).—In 1936 the Ortiz Mining Co. unwatered the Ortiz mine on the Ortiz Grant southeast of Cerrillos and shipped a few cars of gold-silver-copper ore to the El Paso smelter; in March 1937 the company sold its lease to the Santa Cruz Mining Co., which started work on straightening the 250-foot shaft and repairing mine timbering at other underground workings. Small lots of gold ore were shipped early in 1936 from the Benton mine near the Ortiz, but the Benton mine was idle most of the year.

San Pedro or New Placers district.—Lessees at the La Santa Fe group in 1936 recovered small lots of bullion from high-grade gold ore found in small quartz veins. A car of gold-silver-copper ore was shipped from the San Pedro group to the El Paso smelter. Small sluicing and dry-washing operations yielded placer gold which was marketed through mercantile establishments or sent direct to the Denver Mint.

SIERRA COUNTY

Chloride (Apache, Cuchillo Negro) district.—In 1936 lessees at the Great Republic mine 15 miles by road northwest of Winston shipped several lots of siliceous gold-silver ore containing a little copper to the El Paso smelter. The 35-ton gravity- and flotation-concentration mill at the mine was run for a short period late in the year. In March 1937 the mine was leased by another company which in April was shipping 10 to 15 tons of ore a day to the El Paso smelter. The Fortuna and Ivanhoe claims each shipped a 1-ton lot of ore in 1936, and prospects in the district shipped 3 tons.

Hermosa district.—The only output from mines in the Hermosa district in 1936 was 10 tons of lead-silver ore reported to have come from the Pelican group.

Kingston district.—Lessees operated the Keystone mine in the Black Range Mountains on North Percha Creek part of 1936 and shipped several cars of dry silver ore to the El Paso smelter. The other producer in the Kingston district was the Miners Dream-Smiling Jane group which shipped small lots intermittently during the year.

Lake Valley district.—The only producing mine in the Lake Valley district in 1936 was the Lake Valley group which, although producing chiefly manganese ore, yielded one car of gold-silver-lead ore (containing a small percentage of copper) which was shipped to the El Paso smelter.

Las Animas district (Hillsboro).—In 1936, as in 1935 and 1934, the John I. Hallett Construction Co., operating the Animas Consolidated and Slease leases (a consolidation of the old Gold Dust and other placers, totaling 1,200 acres), was the largest producer of placer gold in the Hillsboro district and in the State. The equipment used in 1936 comprised two Northwest dragline excavators, each with a capacity of 1,200 cubic yards per 24 hours, and a portable Coulter-Ainlay recovery plant with four Ainlay 36-inch bowls using gasoline engines for power. Operations were continuous in 1936, and the company handled 100,000 yards of material. There were no other important individual producers from placers in the district in 1936, but scattered small-scale operations contributed to the placer output.

The largest producer from lode mines in the Hillsboro district in 1936 was the Wicks mine in Wicks Gulch, operated continuously by A. A. Luck; the ore was shipped crude to the El Paso smelter. The only other producers of as much as a car of ore were the Biglow-Empire-Bonanza and Portland-Sherman-Caballero groups.

Pittsburg district.—At the property of the Pittsburg Placer Mining Co., lying between the Rio Grande River and the Caballo Mountains 3 miles northeast of Arrey, the Consolidated Mines, Inc., operated its dragline excavator and sluicing equipment for about 2 months in the first part of 1936 and then shut down; later, operations were started by W. T. Warnick, who continued production until December. This property was the second largest producer of placer gold in the State in 1936. Small sluicing operations in the Pittsburg district yielded 43 fine ounces of gold.

SOCORRO COUNTY

Magdalena district.—In 1936 the Kelly mine group of the Empire Zinc Co. was operated continuously under lease to Kenneth Hughes until December 15, when operations were discontinued. The mine

produces zinc-lead sulphide ore. The entire output in 1936 was shipped to the Ozark Smelting & Mining Co. at Coffeyville, Kans. A car of gold ore was shipped from the Morning Star mine to the El Paso smelter, and several lots of lead-silver-gold ore were shipped from the Queen group.

Rosedale district.—In 1936 the Rosedale Gold Mines, Ltd., operated its 75-ton cyanidation mill for 324 days on ore from the Rosedale mine, at an average daily rate of 50 tons. The mine is opened by a 700-foot shaft and approximately 1 mile of drifts. The ore is crushed, ground, and classified; the overflow from the classifier goes to a Deister table, from which the heads go to the smelter and the tails to cyanide tanks. Precipitation is accomplished in zinc boxes. Gold-silver bullion recovered is sold to the mint. A new conveying system and one new crusher were added to the mill equipment in 1936.

San Mateo Mountains district.—The Springtime Mining Co., which has been developing the Panky mine and producing some ore annually since 1934, continued operations until the latter part of 1936, when the company closed the mine. The ore in both 1936 and 1935 was treated in a 40-ton flotation mill at the mine. A small quantity of gold bullion was recovered by hand in 1936 from ore found at a prospect a few miles south of the Panky mine.

TAOS COUNTY

Red River district.—The Myrtle Mines, Inc., operated the Jay Hawk claim from January 1 to April 1, 1936, and treated 500 tons of ore in the 35-ton flotation mill at the property. The product was gold-silver concentrates, which were shipped to the El Paso smelter. In October the Taos Mining & Milling Co. took over the Jay Hawk claim and the Caribel property under bond and lease. A 1-ton lot of gold ore was shipped from the Midway claim to the Golden Cycle mill at Colorado Springs, Colo.

In 1936 the Molybdenum Corporation of America continued operations at the Phyllis group on Sulphur Creek. The molybdenum ore is treated in the company 40-ton (per 24 hours) flotation mill at the junction of Sulphur Creek and Red River above Questa.

TORRANCE COUNTY

Carocito district.—A car of copper ore was shipped from Encino to the El Paso smelter in 1936.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN OREGON

(MINE REPORT)

By Charles White Merrill and H. M. Gaylord

SUMMARY OUTLINE

The output of gold, silver, copper, lead, and zinc from Oregon ores, gravels, and re-treated tailings in 1936, in terms of recovered metals, was 60,753 fine ounces of gold valued at $2,126,355; 85,061 fine ounces of silver valued at $65,880; 574,000 pounds of copper valued at $52,808; 158,000 pounds of lead valued at $7,268; and 122,000 pounds of zinc valued at $6,100—a total of $2,258,411 for the five metals. In 1935 Oregon mines yielded 54,160.11 ounces of gold valued at $1,895,604; 110,385 ounces of silver valued at $79,339; 397,800 pounds of copper valued at $33,017; and 59,575 pounds of lead valued at $2,383—a total of $2,010,343 for the four metals; no output of zinc was reported for 1935. Both the quantity and value of all the metals except silver increased substantially over 1935. Gold increased 12 percent in both quantity and value; copper, 44 percent in quantity and 60 percent in value; lead, 165 percent in quantity and 205 percent in value; and zinc was produced in 1936 following complete cessation of output in 1935. Silver decreased 23 percent in quantity and 17 percent in value.

The total value of the metal output was 12 percent greater in 1936 than in 1935; moreover, the upward trend in quantity production carried the total value in 1936 above that in any year since 1917. Gold has provided the principal revenue of the metal miners of Oregon and in 1936 accounted for 94 percent of the total value of the five metals.

Baker County continued to be the leading metal producer of the State, followed closely by Grant County, and these two counties accounted for over two-thirds of the total value. Most of the remainder came from Josephine, Jackson, and Lane Counties, but some metal output was reported from 11 other counties.

Placer mines yielded approximately two-thirds of the State output of gold in 1936; the leading producing counties, in order of importance, were Grant, Baker, Josephine, and Jackson. Many of the placer operators mined during only a few weeks or months, often because of scarcity of water; on the other hand, a small group of dredge and hydraulic operators worked almost continuously throughout the year.

Five conventional dredges of the connected-bucket type handled 5,148,000 cubic yards of gravel in 1936, which yielded 17,067.26 fine

ounces of gold; the average value of recovered gold per cubic yard treated was 11.6 cents.

Equipment consisting of a power shovel of the dragline type delivering gravel to a floating washing plant is designated a "dragline dredge." Four such operations handled 2,066,000 cubic yards of gravel in 1936 to recover 12,989.42 fine ounces of gold, an average recovery of 22 cents per cubic yard.

Operations using power shovels or other types of mechanical excavators to deliver gravel to nonfloating washing plants are designated "dry-land dredges." Six such operations handled 136,000 cubic yards of gravel in 1936 to recover 1,479.21 fine ounces of gold, an average recovery of 38.1 cents per cubic yard.

Fifty-two hydraulic operations reported the extraction of 2,677.05 fine ounces of gold in 1936 from 1,051,000 cubic yards of gravel, an average of 8.9 cents per cubic yard. The gravel treated at the 20 drift operations reported was very much higher in grade, averaging $2.726 in gold per cubic yard; the total recovery of gold from drift mining was 422.21 fine ounces. The remaining 4,785.85 fine ounces of the placer-gold output were recovered by miners using small-scale hand methods, of whom 79 reported they worked mines or claims; a very much larger number apparently worked the creeks as snipers. No dry placering was reported.

The largest producers in 1936 among the dredging companies were: Ferris & Marchbank in Grant County, using a dragline dredge, and the Sumpter Valley Dredging Co. in Baker County, the Rogue River Gold Co. in Josephine County, and the Timms Gold Dredging Co. and the Monarch Gold Dredging Co. in Grant County, all four using the connected-bucket type of dredge.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the prices given in the table that follows. Gold in 1932 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1837, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95 per ounce, the yearly average weighted United States Government price [1]; and in 1935 and 1936 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1932 and 1933 is the average New York price for bar silver; in 1934, the Treasury buying price ($0.64646464+ per ounce) for newly mined silver; and in 1935 and 1936, the yearly average weighted Treasury buying price for newly mined silver. The copper, lead, and zinc prices are weighted yearly averages of all grades of primary metal sold by producers.

Prices of gold, silver, copper, lead, and zinc, 1932–36

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[1] $20.67+	$0.282	$0.063	$0.030	$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050

[1] $20.671835. [2] $0.64646464.

[1] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Mine production of gold, silver, copper, lead, and zinc in Oregon, 1932–36, in terms of recovered metals

Year	Mines producing		Ore, old tailings, etc. (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1932	99	169	5,195	19,861.21	$410,568	8,616	$2,430
1933	111	292	11,557	20,239.66	517,326	20,760	7,266
1934	95	332	62,145	33,711.59	1,178,220	46,560	30,099
1935	115	268	184,543	54,160.11	1,895,604	110,385	79,339
1936	93	166	136,338	60,753.00	2,126,355	85,061	65,880

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1932	32,199	$2,029	7,917	$238	12,061	$362	$415,627
1933	11,453	733	9,379	347	12,290	516	526,188
1934	38,373	3,070	41,603	1,539	73,184	3,147	1,216,075
1935	397,800	33,017	59,575	2,383			2,010,343
1936	574,000	52,808	158,000	7,268	122,000	6,100	2,258,411

Gold.—The production of gold in Oregon in 1936 was 60,753 fine ounces valued at $2,126,355, an increase of 12 percent in both quantity and value over 1935; 65 percent of the total came from placer mines and 35 percent from lode properties. Production from lode properties declined slightly more than 100 ounces, but that from placers increased almost 7,000 ounces. Baker County yielded over half of the lode-gold output of the State and over one-fourth of the placer gold; Grant County, whose total gold output was somewhat less than that of Baker County, led in output of placer gold. Almost all the rest of the gold produced in the State in 1936 came from Josephine, Jackson, and Lane Counties. Virtually all the gold, other than that recovered from gravel, was derived from dry gold ore or from old siliceous tailings. More than half of the lode gold was recovered by concentration followed by smelting of the resulting concentrates. Among placer operators a large increase was recorded in production by connected-bucket dredges and dragline dredges, but there was a sharp decline in output by hydraulic and small-scale hand methods. Drought affected hydraulic and most of the hand methods adversely, and returning prosperity undoubtedly tended to reduce greatly the number of snipers on the creeks.

Silver.—The production of silver in Oregon in 1936 amounted to 85,061 fine ounces valued at $65,880, a decrease of 23 percent in quantity and 17 percent in value from 1935. Baker County yielded over half and Grant County almost one-fourth of the State total. Nearly 90 percent of the silver produced came from dry gold ores. Concentration followed by smelting of the resulting concentrates was the principal method of recovery.

Copper.—The output of copper in Oregon was 574,000 pounds valued at $52,808 in 1936 compared with 397,800 pounds valued at $33,017 in 1935. All the copper produced in 1936 came from Baker, Douglas, and Lane Counties, where most of it was recovered as a byproduct of the concentration of dry gold ores; copper ore was produced in Douglas County.

Lead.—The production of lead in Oregon in 1936 amounted to 158,000 pounds valued at $7,268, an increase of 165 percent in quantity and 205 percent in value over 1935. Nearly 90 percent of it was reported from Lane County.

Zinc.—The output of zinc in Oregon in 1936 totaled 122,000 pounds valued at $6,100 and was reported as recovered from ore mined in Lane County; no output was recorded for 1935.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Oregon, 1935–36, by counties, in terms of recovered metals

County	Gold						Silver (lode and placer)[1]		Copper		Lead		Zinc		Total value
	Lode		Placer		Total										
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
1935															
Baker	12,796.36	$447,873	7,288.40	$255,094	20,084.76	$702,967	84,350	$60,627	352,945	$29,294	2,610	$104			$792,992
Coos			77.50	2,712	77.50	2,712	6	4							2,716
Curry	368.50	12,897	353.82	12,384	722.32	25,281	87	63							25,344
Douglas	133.12	4,659	349.25	12,224	482.37	16,883	98	70	384	32					16,985
Grant	1,466.56	51,330	9,308.61	325,801	10,775.17	377,131	7,132	5,126	6,807	565	1,079	43			382,865
Harney	4.62	162	1.01	35	5.63	197	1	1							198
Jackson	3,745.81	131,103	5,766.25	201,819	9,512.06	332,922	5,677	4,080	4,918	408	1,920	77			337,487
Jefferson	314.94	11,023			314.94	11,023	7,471	5,370	4,026	334	5,794	232			16,959
Josephine	732.04	25,621	9,283.59	324,926	10,015.63	350,547	1,021	734	167	14	50	2			351,297
Lane	1,842.99	64,505	14.34	502	1,857.33	65,007	4,440	3,191	28,541	2,369	48,106	1,924			72,491
Linn	43.40	1,519	24.49	857	67.89	2,376	16	11							2,387
Malheur			117.28	4,105	117.28	4,105	18	13							4,118
Marion			8.74	306	8.74	306									306
Umatilla			20.99	735	20.99	735									735
Union	.02	1	13.64	477	13.66	478	58	42	12	1	16	1			522
Wheeler	7.72	270	55.26	1,934	62.98	2,204	10	7							2,211
Unallocated[2]			20.86	730	20.86	730									730
	21,456.08	750,963	32,704.03	1,144,641	54,160.11	1,895,604	110,385	79,339	397,800	33,017	59,575	2,383			2,010,343

[1] Source of total silver, as follows: 1935, 106,410 ounces from lode mines and 3,975 ounces from placers; 1936, 79,411 ounces from lode mines and 5,650 ounces from placers.
[2] No information as to county of origin.

Mine production of gold, silver, copper, lead, and zinc in Oregon, 1935–36, by counties, in terms of recovered metals—Continued

County	Gold						Silver (lode and placer)		Copper		Lead		Zinc		Total value
	Lode		Placer		Total										
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
1936															
Baker	12,700.00	$444,500	10,110.00	$353,850	22,810.00	$798,350	51,375	$39,790	422,000	$38,824	14,000	$644			$877,608
Coos			98.00	3,430	98.00	3,430	16	12							3,442
Curry	23.00	805	211.00	7,385	234.00	8,190	30	23							8,213
Douglas	246.00	8,610	248.00	8,680	494.00	17,290	4,420	3,423	118,000	10,856					31,569
Grant	2,434.00	85,190	17,803.00	623,105	20,237.00	708,295	19,814	15,346							723,641
Jackson	2,597.00	90,895	2,690.00	94,150	5,287.00	185,045	3,686	2,855			4,000	184			188,084
Josephine	1,516.00	53,060	8,156.00	285,460	9,672.00	338,520	1,220	945							339,465
Lane	1,806.00	63,210	(3)	(3)	[4] 1,806.00	[4] 63,210	4,476	3,467	34,000	3,128	140,000	6,440	122,000	$6,100	[4] 82,345
Lincoln			3.00	105	3.00	105									105
Linn			4.00	140	4.00	140	2	2							142
Malheur	6.00	210	55.00	1,925	61.00	2,135	11	9							2,144
Umatilla			2.00	70	2.00	70									70
Other counties [5]	4.00	140	41.00	1,435	45.00	1,575	11	8							1,583
	21,332.00	746,620	39,421.00	1,379,735	60,753.00	2,126,355	85,061	65,880	574,000	52,808	158,000	7,268	122,000	6,100	2,258,411

[3] Included under "Other counties."
[4] Exclusive of placer output, which is included under "Other counties."
[5] Includes Harney, Morrow, Union, and Wheeler Counties and placer output of Lane County.

Ore, old tailings, etc., sold or treated and lode and placer mines producing in Oregon, 1935-36, by counties

County	Lode						Placer mines producing [1]	
	Material sold or treated (short tons)				Mines producing [1]			
	1935		1936					
	Ore	Old tailings, etc.	Ore	Old tailings	1935	1936	1935	1936
Baker	37,507	106,831	55,123	33,371	28	26	51	28
Coos	-	-	-	-	-	-	13	8
Curry	14	-	9	-	2	2	16	6
Douglas	553	-	1,278	-	4	4	14	3
Grant	4,302	-	11,929	3,416	17	17	41	24
Harney	28	-	1	-	2	1	-	2
Jackson	25,321	37	17,222	-	28	20	32	23
Jefferson	200	-	-	-	1	-	-	-
Josephine	1,317	390	5,908	400	21	19	88	62
Lane	7,916	-	7,675	-	6	3	-	1
Lincoln	-	-	-	-	-	-	-	1
Linn	116	-	-	-	4	-	4	-
Malheur	-	-	6	-	-	1	5	4
Morrow	-	-	-	-	-	-	-	1
Umatilla	-	-	-	-	-	-	1	-
Union	1	-	-	-	1	-	-	1
Wheeler	10	-	-	-	1	-	3	2
	77,285	107,258	99,151	37,187	115	93	268	166

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

MINING INDUSTRY

The increased price of gold during the last few years has been particularly favorable to the Oregon metal-mining industry, because most of the metal output of the State (94 percent of the value in 1936) is accounted for by gold. A few dredges and a few lode mines, operated almost exclusively for gold, accounted for the larger part of the State metal production. The dragline dredge has been the outstanding factor in Oregon's increasing gold production in the last few years. The reopening of old lode mines, however, has also contributed substantially to the output. So far, the expansion in the metal-mining industry has centered about gold.

Gold produced at placer mines in Oregon, 1935–36, by classes of mines and by methods of recovery

Class and method	Mines producing [1]	Material treated (cubic yards)	Gold recovered: Fine ounces	Gold recovered: Value	Gold recovered: Average per cubic yard
1935					
Surface placers:					
Gravel mechanically handled:					
Floating dredge with connected buckets	5	2,777,059	10,467.08	$366,348	$0.132
Dragline dredge [2]	9	1,903,620	6,495.34	227,337	.119
Dry-land dredge [3]	1	1,200	5.06	177	.148
Suction dredge	1	(4)	16.32	571	(4)
Gravel hydraulically handled: Hydraulic	75	(4)	4,687.20	164,052	(4)
Small-scale hand methods: Wet (sluice, long tom, dip box, pan, etc.)	152	(4)	10,616.61	371,581	(4)
Underground placers: Drift	25	(4)	416.42	14,575	(4)
	268	(4)	32,704.03	1,144,641	(4)
1936					
Surface placers:					
Gravel mechanically handled:					
Floating dredge with connected buckets	5	5,148,000	17,067.26	597,354	.116
Dragline dredge [2]	4	2,066,000	12,989.42	454,630	.220
Dry-land dredge [3]	6	136,000	1,479.21	51,772	.381
Gravel hydraulically handled: Hydraulic	52	1,051,000	2,677.05	93,697	.089
Small-scale hand methods: Wet (sluice, long tom, dip box, pan, etc.)	79	(4)	4,785.85	167,505	(4)
Underground placers: Drift	20	5,420	422.21	14,777	2.726
	166	(4)	39,421.00	1,379,735	(4)

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Includes all placer operations using dragline type of power shovel for excavating and delivering gravel to floating washing plant.
[3] Includes all placer operations using power excavator and washing plant, both on dry land.
[4] Data not available.

ORE CLASSIFICATION

Ore, old tailings, etc., sold or treated in Oregon, 1935–36, with content in terms of recovered metals

Source	Material sold or treated: Ore	Material sold or treated: Old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold ore	77,259	107,258	21,306.05	106,277	395,652	59,559	
Dry silver ore	2		.03	92	12	16	
Copper ore	24		150.00	41	2,136		
Total, lode mines	77,285	107,258	21,456.08	106,410	397,800	59,575	
Total, placers			32,704.03	3,975			
	77,285	107,258	54,160.11	110,385	397,800	59,575	
1936							
Dry gold ore	98,149	37,187	21,200.54	75,090	456,000	158,000	122,000
Copper ore	1,002		131.46	4,321	118,000		
Total, lode mines	99,151	37,187	21,332.00	79,411	574,000	158,000	122,000
Total, placers			39,421.00	5,650			
	99,151	37,187	60,753.00	85,061	574,000	158,000	122,000

Dry gold ore, old tailings, etc., sold or treated in Oregon, 1935–36, by counties, with content in terms of recovered metals

County	Material sold or treated		Gold	Silver	Copper	Lead	Zinc
	Ore	Old tailings, etc.					
1935	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Baker	37,487	106,831	12,653.36	82,990	351,645	2,610	
Curry	14		368.50	58			
Douglas	551		132.96	76	80		
Grant	4,301		1,462.69	5,996	6,420	1,079	
Harney	28		4.62	1			
Jackson	25,321	37	3,745.81	5,091	4,918	1,920	
Jefferson	200		314.94	7,471	4,026	5,794	
Josephine	1,315	390	729.06	141	22	50	
Lane	7,916		1,842.99	4,440	28,541	48,106	
Linn	116		43.40	13			
Wheeler	10		7.72				
	77,259	107,258	21,306.05	106,277	395,652	59,559	
1936							
Baker	55,123	33,371	12,700.00	49,136	422,000	14,000	
Curry	9		23.00	5			
Douglas	276		114.54	69			
Grant	11,929	3,416	2,434.00	17,732			
Harney	1		4.00	8			
Jackson	17,222		2,597.00	3,312		4,000	
Josephine	5,908	400	1,516.00	351			
Lane	7,675		1,806.00	4,476	34,000	140,000	122,000
Malheur	6		6.00	1			
	98,149	37,187	21,200.54	75,090	456,000	158,000	122,000

METALLURGIC INDUSTRY

Of the 136,338 tons of ore (including 37,187 tons of old tailings) sold or treated during 1936 in Oregon, 88,494 tons were produced in Baker County; most of the remainder came from mines in Jackson and Grant Counties. Over 100,000 tons were treated in concentration mills, most of which used flotation; over 30,000 tons were treated in gold and silver mills, some using amalgamation and others cyanidation, both with and without concentration; and the rest (about 2,000 tons) was shipped crude to smelters.

Mine production of metals in Oregon, 1935–36, by methods of recovery

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore and old tailings amalgamated	12,878	3,850.41	866			
Ore and old tailings cyanided	3,390	125.93	50			
Concentrates smelted:						
Flotation	5,711	14,616.38	95,556	385,300	53,099	
Table	132	870.64	1,440	5,722	352	
Ore and old mill cleanings smelted	1,152	1,992.72	8,498	6,778	6,124	
Total, lode mines		21,456.08	106,410	397,800	59,575	
Total, placers		32,704.03	3,975			
		54,160.11	110,385	397,800	59,575	
1936						
Ore amalgamated	29,701	5,005.59	1,218			
Old tailings cyanided	1,900	255.40	351			
Concentrates smelted:						
Flotation	5,687	14,215.59	71,739	443,280	134,385	122,000
Table	27	100.06	172			
Ore smelted	2,058	1,755.36	5,931	130,720	23,615	
Total, lode mines		21,332.00	79,411	574,000	158,000	122,000
Total, placers		39,421.00	5,650			
		60,753.00	85,061	574,000	158,000	122,000

Mine production of metals from gold and silver mills in Oregon, 1935-36, by counties, in terms of recovered metals

County	Material treated		Recovered in bullion		Concentrates and recovered metal					
	Ore	Old tailings	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1935										
Baker	6,690	1,700	1,187.04	210	40	197.38	335	3,836		
Curry	13		251.20	38	1	16.10	3			
Douglas	451		69.40	6	1	5.62				
Grant	797		315.57	91	4	13.03	32	100		
Harney	27		4.13							
Jackson	2,677	37	1,144.95	302	15	71.80	122	280		
Josephine	1,304	390	694.91	137	4	30.49	3		50	
Lane	2,056		258.02	119	179	468.17	1,769	11,046	22,877	
Linn	116		43.40	13						
Wheeler	10		7.72							
	14,141	2,127	3,976.34	916	244	802.59	2,264	15,262	22,927	
1936										
Baker	13,398	1,500	1,933.97	703	64	186.68	111	3,097		
Grant	830		314.47	76	6	15.73	14			
Jackson	2,164		1,088.39	268	6	45.70	37			
Josephine	5,884	400	953.74	197	68	543.97	119			
Other counties [1]	7,425		970.42	325	423	545.38	2,987	25,941	110,797	122,000
	29,701	1,900	5,260.99	1,569	567	1,337.46	3,268	29,038	110,797	122,000

[1] Curry, Douglas, Lane, and Malheur Counties.

Mine production of metals from concentrating mills in Oregon, 1935-36, by counties, in terms of recovered metals

County	Material treated		Concentrates and recovered metal				
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
1935							
Baker	29,986	105,108	3,917	9,984.85	81,743	347,245	2,538
Douglas	100		9	57.94	70	80	
Grant	3,500		384	1,126.76	5,856	6,280	1,079
Jackson	22,610		893	2,489.88	4,599	4,638	1,678
Josephine	10		2	1.40	1	22	
Lane	5,809		394	1,023.60	2,463	17,495	25,229
	62,015	105,108	5,599	14,684.43	94,732	375,760	30,524
1936							
Baker	40,902	31,871	3,889	9,418.03	47,344	406,429	13,182
Grant	10,937	3,416	614	1,938.96	17,440		
Other counties [1]	15,553		644	1,621.20	3,859	7,813	10,406
	67,392	35,287	5,147	12,978.19	68,643	414,242	23,588

[1] Jackson and Lane Counties.

Gross metal content of Oregon concentrates produced, 1935–36, by classes of concentrates

Class of concentrates	Concentrates produced (dry weight)	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1935						
Dry gold	1,307	3,303.95	10,406	6,577	3,808	
Copper	3,972	10,704.34	82,364	367,428	4,160	
Lead	332	742.64	1,650	12,344	34,557	
Copper-lead	232	736.09	2,576	16,787	45,397	
	5,843	15,487.02	96,996	403,136	87,922	
1936						
Dry gold	1,749	4,723.69	26,849	8,443	17,206	
Copper	3,431	8,877.14	40,883	415,539	7,002	
Lead	26	21.20	369		4,000	
Copper-lead	104	193.24	951	8,873	15,225	
Copper-lead-zinc	404	500.38	2,859	26,044	112,912	137,035
	5,714	14,315.65	71,911	458,899	156,345	137,035

Mine production of metals from Oregon concentrates, 1935–36, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1935						
Baker	3,957	10,182.23	82,078	351,081	2,538	
Curry	1	16.10	3			
Douglas	10	63.56	70	80		
Grant	388	1,139.79	5,888	6,380	1,079	
Jackson	908	2,561.68	4,721	4,918	1,678	
Josephine	6	31.89	4	22	50	
Lane	573	1,491.77	4,232	28,541	48,106	
	5,843	15,487.02	96,996	391,022	53,451	
1936						
Baker	3,953	9,604.71	47,455	409,526	13,182	
Grant	620	1,954.69	17,454			
Jackson	546	1,478.14	2,974		3,783	
Josephine	68	543.97	119			
Lane	527	734.14	3,909	33,754	117,420	122,000
	5,714	14,315.65	71,911	443,280	134,385	122,000

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
1935						
Dry gold	1,307	3,303.95	10,406	6,364	2,284	
Copper	3,972	10,704.34	82,364	356,401	2,538	
Lead	332	742.64	1,650	11,974	21,284	
Copper-lead	232	736.09	2,576	16,283	27,345	
	5,843	15,487.02	96,996	391,022	53,451	
1936						
Dry gold	1,749	4,723.69	26,849	6,837	9,901	
Copper	3,431	8,877.14	40,883	403,102	4,200	
Lead	26	21.20	369		3,783	
Copper-lead	104	193.24	951	8,600	9,235	
Copper-lead-zinc	404	500.38	2,859	24,741	107,266	122,000
	5,714	14,315.65	71,911	443,280	134,385	122,000

Gross metal content of Oregon crude ore shipped to smelters, 1935-36, by classes of ore

Class of ore	Ore (dry weight)	Gross metal content			
		Gold	Silver	Copper	Lead
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry gold	1,103	1,809.85	8,199	4,778	10,034
Dry silver	2	.03	92	13	27
Copper	24	150.00	41	2,204	
	1,129	1,959.88	8,332	6,995	10,061
1936					
Dry gold	1,056	1,623.90	1,610	21,024	24,694
Copper	1,002	131.46	4,321	121,888	
	2,058	1,755.36	5,931	142,912	24,694

Mine production of metals from Oregon crude ore shipped to smelters, 1935-36, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Baker	831	1,394.25	600	1,836	72
Curry	1	101.20	17		
Douglas	2	.16	9	304	
Grant	5	11.20	19	427	
Harney	1	.49	1		
Jackson	34	39.18	68		242
Jefferson	200	314.94	7,471	4,026	5,794
Josephine	3	5.24		145	
Lane	51	93.20	89		
Union	1	.02	58	12	16
	1,129	1,959.88	8,332	6,750	6,124
1936					
Baker	823	1,161.32	978	12,474	818
Douglas	1,020	178.32	4,384	118,000	
Grant	162	164.84	202		
Josephine	24	18.29	35		
Other counties [1]	29	232.59	332	246	22,797
	2,058	1,755.36	5,931	130,720	23,615

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead
1935					
Dry gold	1,103	1,809.85	8,199	4,602	6,108
Dry silver	2	.03	92	12	16
Copper	24	150.00	41	2,136	
	1,129	1,959.88	8,332	6,750	6,124
1936					
Dry gold	1,056	1,623.90	1,610	12,720	23,615
Copper	1,002	131.46	4,321	118,000	
	2,058	1,755.36	5,931	130,720	23,615

[1] Curry, Harney, Jackson, and Lane Counties.

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Oregon, 1935–36, by counties and districts, in terms of recovered metals [1]

County and district [1]	Mines producing [2]		Ore, old tailings, etc.	Gold			Silver (lode and placer) [3]	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
1935			Short tons	Fine ounces	Fine ounces	Fine ounces	Fine ounces	Pounds	Pounds	Pounds	
Baker County:											
Baker	6	6	178	152.27	1,038.53	1,190.80	516	536	72		$42,096
Bridgeport		3			50.25	50.25	2				1,760
Bull Run	2	(4)	4,941	1,088.13	1.19	1,089.32	222	5,136			38,712
Cable Cove		(4)			.66	.66					23
Connor Creek		8			181.70	181.70	17				6,372
Cornucopia	2	6	122,345	9,025.57	169.69	9,195.26	81,075	164,694	2,538		393,878
Cow Creek		1			55.93	55.93	9				1,964
Cracker Creek		(4)			3.41	3.41	3				122
Eagle Creek	3	3	15,227	2,143.76	34.57	2,178.33	1,077	182,551			92,167
Greenhorn [5]	2	7	28	38.19	154.28	192.47	183	28			6,870
Pine Creek		3			45.72	45.72	9				1,606
Robinette		1			7.21	7.21	11				260
Rock Creek	1	(4)	20	24.27	.42	24.69	8				870
Stice		(4)			.56	.56					20
Virtue	3	(4)	1,412	118.60	4.82	123.42	11				4,328
Weatherby	5	4	134	187.91	17.26	205.17	92				7,247
Unallocated [6]		(4)			114.79	114.79					4,018
Coos County:											
Johnson Creek [7]		10			38.07	38.07					1,332
Powers		2			18.18	18.18	2				638
Randolph		1			19.86	19.86	4				698
Rock Creek		(4)			1.39	1.39					49
Curry County:											
Agness		2			52.42	52.42	1				1,835
Chetco	1	4	11	333.75	30.66	364.41	55				12,794
China Diggings		(4)			31.86	31.86					1,115
Elk River		(4)			4.25	4.25					149
Johnson Creek [7]		1			1.47	1.47					51
Mule Creek		1			4.24	4.24	1				149
Ophir		1			4.30	4.30					151
Port Orford		(4)			3.91	3.91					137
Sixes River		5			93.11	93.11	11				3,267
Douglas County:											
Coffee Creek		2			21.88	21.88	3				768
Cow Creek		4			165.49	165.49					5,792

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Oregon, 1935–36, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore, old tailings, etc.	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
1935—Continued			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Douglas County—Continued.											
Drew Creek		3			30.43	30.43					$1,065
Green Mountain		1			67.98	67.98	9				2,386
Myrtle Creek		1			27.75	27.75					971
Nuggett	1	1	100	57.94	3.51	61.45	71	80			2,208
Olalla		1			5.19	5.19					182
Riddle	2	1	452	74.48	23.64	98.12	15	304			3,470
Unallocated [6]		(4)			3.38	3.38					118
Grant County:											
Canyon	3	15	62	35.66	6,470.57	6,506.23	745				228,254
El Dorado Canyon		(4)			1.75	1.75					61
Granite	1	9	1,000	304.18	116.61	420.79	3,904	960	1,079		17,656
Greenhorn [6]	8	3	953	375.95	121.33	497.28	1,053				18,162
New El Dorado		(4)			.33	.33					12
North Fork John Day		7			58.54	58.54	10				2,056
Oriental		1			5.04	5.04	1				177
Quartzburg	3	4	256	73.86	38.68	112.54	29	427			3,995
Susanville	2	2	2,031	676.91	2,429.17	3,106.08	1,390	5,420			110,162
Unallocated [6]		(4)			66.59	66.59					2,331
Harney County:											
Pueblo	2		28	4.62		4.62	1				162
Unallocated [6]		(4)			1.01	1.01					35
Jackson County:											
Elk Creek	1	(4)	6	11.50	158.90	170.40	66		475		6,030
Gold Hill	9	14	1,037	513.93	2,544.85	3,058.78	535		1,341		107,495
Greenback [6]		2			22.78	22.78					797
Jacksonville	7	9	22,915	2,641.03	1,290.55	3,931.58	4,690	4,698	104		141,370
Upper Applegate	10	6	420	153.20	1,628.83	1,782.03	224				62,532
Unallocated [6]		(4)			9.13	9.13					320
Jefferson County: Ashwood	1		200	314.91		314.94	7,471	4,026	5,794		16,959
Josephine County:											
Althouse		5			311.09	311.09	39				10,916
Galice	5	20	144	275.64	780.39	1,056.03	72	145	50		37,027
Grants Pass	3	14	12	18.14	615.63	633.77	59	22			22,226
Greenback [6]	4	11	357	98.91	1,910.83	2,009.74	189				70,477
Illinois River	2	12	49	22.52	527.57	550.09	31				19,275
Lower Applegate	3	3	633	171.73	525.56	697.29	90				24,470
Waldo	4	23	512	145.10	4,582.19	4,727.29	541				165,844
Unallocated [6]		(4)			30.33	30.33					1,062

Lane County:											
Blue River	2	(4)	244	31.13	10.50	41.63	162	284	1,051		1,639
Bohemia	4	(4)	7,672	1,811.86	3.84	1,815.70	4,278	28,257	47,055		70,852
Linn County:											
Big Bottom		1			2.52	2.52	2				90
Blue River		1			1.55	1.55					54
Quartsville	4	2	116	43.40	20.42	63.82	14				2,244
Malheur County:											
Malheur		2			49.66	49.66	10				1,745
Mormon Basin [9]		(4)			23.53	23.53					824
Snake River		3			44.09	44.09	8				1,549
Marion County: North Santiam		(4)			8.74	8.74					306
Umatilla County: Ukiah		1			20.99	20.99					735
Union County:											
Camp Carson	1	(4)	1	.02	7.72	7.74	58	12	16		314
Unallocated [6]		(4)			5.92	5.92					207
Wheeler County: Spanish Gulch	1	3	10	7.72	55.26	62.98	10				2,211
Combined districts [10]	7	12	1,037	479.26	5,646.22	6,125.48	1,296	220			215,342
Unallocated [11]		(4)			20.86	20.86					730
Total Oregon	115	268	184,543	21,456.08	32,704.03	54,160.11	110,385	397,800	59,575		2,010,343
1936											
Baker County:											
Connor Creek		5			102.55	102.55	13				3,599
Cornucopia	(12)	4	(12)	(12)	182.81	[13] 182.81	[13] 26	(12)	(12)		[13] 6,418
Mormon Basin [9]		9			1,031.26	1,031.26	146				36,207
Sparta	3		1,467	288.20		288.20	112				10,174
Sumpter	(12)	3	(12)	(12)	8,311.35	[13] 8,311.35	[13] 2,014		(12)		[13] 292,457
Virtue	3	(4)	3,179	989.49	15.00	1,004.49	433				35,493
Weatherby	7	(12)	157	88.99	(12)	[14] 88.99	[14] 93				[14] 3,187
Coos County: Johnson Creek [7]		7			91.96	91.96	15				3,230
Curry County:											
Chetco	(12)	(4)	(12)	(12)	1.00	[13] 1.00	(12)				[13] 35
Gold Beach		(4)			45.62	45.62	6				1,601
Mule Creek		3			39.01	39.01	4				1,368
Douglas County:											
Coffee Creek		(4)			50.92	50.92	7				1,788
Myrtle Creek	(12)	(4)	(12)	(12)	51.21	[13] 51.21	[13] 7				[13] 1,798
Riddle	3		1,262	204.53		204.53	4,328	118,000			21,367
Grant County:											
Canyon	4	11	154	85.21	14,146.21	14,231.42	1,516				499,274
Granite	3	4	186	121.51	215.10	336.61	255				11,979
Greenhorn [5]	4	3	14,443	2,063.93	88.05	2,151.98	17,399				88,795
Quartzburg	5	(12)	561	160.70	(12)	[14] 160.70	[14] 59				[14] 5,670
Susanville	(12)	3	(12)	(12)	3,264.32	[13] 3,264.32	[13] 510				[13] 114,646
Jackson County:											
Gold Hill	5	7	542	352.96	1,060.69	1,413.65	217				49,646
Greenback [8]	(12)	(4)	(12)	(12)	181.58	[13] 181.58	[13] 32				[13] 6,380
Jacksonville	6	5	14,156	1,461.57	550.75	2,012.32	2,671				72,500
Upper Applegate	3	8	26	139.80	793.03	932.83	134				32,753

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Oregon, 1935–36, by counties and districts, in terms of recovered metals—Continued

County and district—Continued	Mines producing		Ore, old tailings, etc.	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
1936—Continued			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Josephine County:											
Althouse		3			136.88	136.88	19				$4,806
Galice	7	14	3,640	904.10	777.20	1,681.30	268				59,053
Grants Pass	(12)	6	(12)	(12)	487.62	[13] 487.62	[13] 62				[13] 17,115
Greenback [8]	4	14	1,328	451.34	4,389.95	4,841.29	550				169,871
Illinois River	3	9	45	21.04	420.14	441.18	46				15,477
Lower Applegate	(12)	4	(12)	(12)	245.37	[13] 245.37	[13] 29				[13] 8,610
Waldo	(12)	12	(12)	(12)	1,698.84	[13] 1,698.84	[13] 214				[13] 59,625
Lane County: Bohemia	3	(12)	7,675	1,806.00	(12)	[14] 1,806.00	4,476	34,000	140,000	122,000	[14] 82,345
Linn County: Blue River		(4)			4.00	4.00	1				141
Malheur County:											
Mormon Basin [9]		4			50.33	50.33	10				1,769
Snake River		(4)			4.67	4.67					163
Umatilla County: Ukiah		(4)			2.00	2.00					70
Combined districts [15]	30	28	87,517	12,192.63	981.58	13,174.21	49,389	422,000	18,000		539,001
Total Oregon	93	166	136,338	21,332.00	39,421.00	60,753.00	85,061	574,000	158,000	122,000	2,258,411

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures; other producing districts listed in footnotes 10 and 15 and their output included under "Combined districts."

[2] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

[3] Source of total silver as follows: 1935, 106,410 ounces from lode mines and 3,975 ounces from placers; 1936, 79,411 ounces from lode mines and 5,650 ounces from placers.

[4] No information as to number of producers (see footnote 2).

[5] Greenhorn district lies in both Baker and Grant Counties.

[6] No information as to district of origin.

[7] Johnson Creek district lies in both Coos and Curry Counties.

[8] Greenback district lies in both Jackson and Josephine Counties.

[9] Mormon Basin district lies in both Baker and Malheur Counties.

[10] Includes following districts: Mormon Basin, Sparta, and Sumpter in Baker County; Cape Blanco and Gold Beach in Curry County; Shively in Douglas County; and Ashland in Jackson County.

[11] No information as to district or county of origin.

[12] Included under "Combined districts."

[13] Exclusive of lode output, which is included under "Combined districts."

[14] Exclusive of placer output, which is included under "Combined districts."

[15] Includes following districts: Baker, Bull Run, Cable Cove, Cornucopia (lode), Cow Creek, Cracker Creek, Greenhorn, Rock Creek, Snake River, Sumpter (lode), and Weatherby (placer) in Baker County; Agness in Coos County; Chetco (lode), China Diggings, Port Orford, and Sixes in Curry County; Cow Creek, Drew Creek, Green Mountain, and Myrtle Creek (lode) in Douglas County; Desolation, North Fork John Day, Quartzburg (placer), and Susanville (lode) in Grant County; Harney in Harney County; Ashland, Elk Creek, Greenback (lode), Jump-off Joe, and Rogue River in Jackson County; Grants Pass (lode), Lower Applegate (lode), and Waldo (lode) in Josephine County; Bohemia (placer) in Lane County; Beach in Lincoln County; Malheur in Malheur County; Boardman in Morrow County; Camp Carson in Union County; and Spanish Gulch in Wheeler County.

EASTERN OREGON

Baker County.—In the Baker district the largest producer in 1936 was the Balm Creek Gold Mining Co., which operated the Balm Creek mine formerly worked by the Oregon Copper Co. Most of the ore from this mine was treated in the company 100-ton flotation mill, but a small quantity was shipped crude with the flotation concentrates to a copper smelter. The principal content was gold, but copper contributed substantially to the mine revenue. Over 5,000 feet of development work were done during the year, and stoping was begun on the lower levels after the mine had been unwatered. Small-scale miners operating in the district produced more than 200 fine ounces of gold.

In the Bull Run district virtually all the gold produced in 1936 came from the property operated by the Record Gold Mining Co. The company ore was amalgamated and floated, and the concentrates were shipped to a smelter; 100 feet of sinking were done at the property during the year. In addition to the lode output of the district a little gold was reported from small-scale placer mines.

In the Connor Creek district a number of small placer operators were reported at work during 1936.

In the Cornucopia district the Cornucopia Gold Mines had a larger output in 1936 than any lode mine in Oregon. Of the material treated at the two flotation mills (300-ton and 100-ton) of the company, a little over one-third was ore and the remainder old tailings; the resulting concentrates were shipped to a copper smelter. Most of the value was gold, but silver contributed substantially to the mine revenue and copper brought a smaller return. Development work during the year was reported as 15,000 feet, including completion of the 6,000-foot Coulter tunnel giving access to the deeper ore bodies. The mine and mill employed an average of 125 men throughout the year. Almost all the other output of the district came from placer operations, the largest of which was Ingram Placers, Inc., on Pine Creek, a drift mine working a glacial channel.

In the Cow Creek district in 1936 the Harrison Gold Dredging Co. worked creek gravel with a power shovel and washing plant.

In the Cracker Creek district gold ore was shipped in 1936 from the Golconda and the Argonaut properties.

In that part of the Greenhorn district extending into Baker from Grant County several producers in 1936 were reported.

In the Mormon Basin district placer mining was active in 1936. The leading producer was the Pioneer Gold Dredging Co. which worked the Clarks Creek placer; this company operated an electric dredge of the connected-bucket type, having a capacity of 4,000 cubic yards per 24 hours. A small output was reported from the Dry Horseshoe drift mine. The Rye Valley placer on Dixie Creek was worked by hydraulicking. The aggregate output of small producers in the district was substantial.

In the Rock Creek district the Highland and the Baisley-Elkhorn properties were the leading producers in 1936. At the former ore was treated by flotation, and at the latter crude gold ore was shipped for smelting.

In the Sparta district the Gem of Sparta mine was the leading producer in 1936; it was operated part of the year by the Sparta Gold Mining Co. and later by the Gem Cooperative, a group of seven men.

Development work was reported at the Macy mine and at the Gold Ridge claims.

In the Sumpter district the Mountain View property was the most productive lode-gold mine in 1936. The importance of the district, however, is due to its placer output. The leading producer was the Sumpter Valley Dredging Co., which operated an electric dredge of the connected-bucket type, having a capacity of 8,000 cubic yards per 24 hours. An average of 23 men was employed at the property throughout the year. The material worked was described as lake-bed gravel. A dry-land dredge at the Harris placer produced placer gold. In addition, a large number of small placer operators reported output.

In the Virtue district White Swan Gold, Inc., working the White Swan mine, was the outstanding producer in 1936. The company mined gold ore and treated it by amalgamation.

In the Weatherby district a number of operators made small outputs of gold in 1936 from both lode and placer mines, and considerable development work was done.

Grant County.—In the Canyon district the principal output in 1936 was placer gold. Ferris & Marchbank, the leading producer, operated a dragline dredge. The plant capacity was 6,000 cubic yards per 24 hours; the dragline used Diesel-electric power and the washing plant, Diesel power. An average of 24 men was employed at the property throughout the year. The Monarch Gold Dredging Co., another large operator, used a floating dredge of the connected-bucket type, having a daily capacity of 3,000 cubic yards; an average of 13 men was employed most of the year. Other operations in the district included both lode and placer mines.

In the Granite district gold was the principal metal produced in 1936; it came from both lode and placer properties. The most productive mine, the Hope placer on Bull Run Creek, was worked by a gasoline-powered dry-land dredge with dragline excavator and a washing plant mounted on skids. An average of 5 men was employed during the 5 months that work was carried on.

In the Greenhorn district the Ben Harrison mine, worked by the Campbell Mining Co., was the leading producer in 1936. The company built a 100-ton flotation mill which began operating May 1; during the construction period the old mine was reopened. Material treated during the year was approximately three-fourths ore and one-fourth old tailings; revenue recovered came largely from gold, but silver was a very important byproduct. About 800 feet of development work were done during the year. The Red Bird mine started operations late in 1936 and produced a small quantity of gold ore which was amalgamated. Several other small lode and placer operations were reported in the district; one of the more important was the Vinegar Creek placer, where 8,000 cubic yards of bench gravel were hydraulicked.

On the North Fork of John Day River a gasoline shovel and dry-land washing plant were used in 1936 on 6,000 cubic yards of auriferous gravel.

In the Quartzburg district a number of small lode- and placer-gold mines were worked in 1936.

In the Susanville district in 1936 the Timms Gold Dredging Co. operated an electric dredge of the connected-bucket type, having a capacity of 2,000 cubic yards per day; an average of 17 men was employed after operations were begun in March.

Other counties.—Virtually all the rest of the output from eastern Oregon in 1936 came from mines in Harney and Malheur Counties, but very small outputs were reported from Morrow, Umatilla, Union, and Wheeler Counties.

WESTERN OREGON

Coos and Curry Counties.—Placer gold was reported produced in 1936 in the Agness and Johnson Creek districts in Coos County and the Chetco, Gold Beach, Mule Creek, Port Orford, and Sixes districts in Curry County; the output from neither county was large. The largest producer was the property at Cape Blanco in Curry County, operated by Dorothy Faris and associates who worked beach sand by sluicing and produced important quantities of platinum and osmiridium along with the gold.

Douglas County.—In the Riddle district in 1936 the Silver Peak mine started operations in July and made a number of shipments of copper ore containing gold and silver; at the Huckleberry group mine operations resulted in free-milling ore which was amalgamated for gold; and several other lode mines reported smaller output, as well as prospecting and development work. Placer mining in Douglas County was most active in the Coffee Creek, Cow Creek, Drew Creek, Green Mountain, and Myrtle Creek districts; much of the output came from small operators who sold their products through local gold buyers.

Jackson County.—In the Ashland district the Ashland mine was among the 10 leading lode mines of the State in 1936 in tonnage produced and in gross value of recovery therefrom. The principal value was gold. The mine was operated throughout the year and the mill during the last 9 months. An average of eight men was employed, and mine development comprised 250 feet of new work and 2,000 feet of shaft and level reclamation following unwatering of the lower levels.

In the Elk Creek district the chief operations in 1936 were at the Al Sarena mine and the Rhyolite mining claim; at both properties the principal product was gold.

In the Gold Hill district several mines produced gold during 1936. The largest lode operation was at the Sylvanite mine, but the bulk of the district output came from placers. The Charles W. Kitts placer property was worked during the early weeks of 1936 by Rogue River Dredgers, Inc.; the equipment, a dragline dredge, lay idle some months until work was resumed under different management in August. Several other small operations were reported, and more than 600 fine ounces of gold were sold, by small-scale miners working the creeks, to gold buyers serving the district.

In the Jacksonville district the Opp mine, the largest lode operation in western Oregon in 1936, was worked by the Pacific States Mines, Inc. The company had an average of 24 men working from the first of the year until operations ceased at the end of August. The ore was treated by flotation; the resulting concentrate, the principal value in which was gold, was shipped to a smelter. The leading placer mine in the district was the Alaska of Oregon worked by the Alaska of Oregon Mines Co., which had a stationary washing plant with a capacity of 1,200 cubic yards per day; the gravel was delivered to the plant by trucks loaded by a steam shovel. Production was reported to have been incidental to testing work. There were a number of other small operations, both lode and placer, in the district, and small-scale miners selling through local gold buyers produced 300 ounces of fine gold.

In the Upper Applegate district a number of small lode and placer operations were productive in 1936. One of the largest was that at the Mountain Home drift mine, where an average of five men was employed during the first 6 months of the year. More than 200 fine ounces of gold were sold by small-scale miners in the district through local gold buyers.

Josephine County.—In the Althouse district, although there were several operators in 1936, most of the gold was recovered by hydraulicking at the Independence mine.

In the Galice district the largest operation in 1936 was that of the H. & M. Development Co., Inc., at the Oriole mine. Some old tailings were cyanided at the Bunker Hill mine, and production of gold ore was reported at the J. C. L. mine. The largest placer output in the district came from hydraulicking at the Old Channel mine, where three giants under 375 feet of head worked during the early months of the year. The Dean & Dean property also was worked by the hydraulic method. Placer operations throughout the district, however, were curtailed by the drought, which caused a serious shortage of water for mining purposes. Over 300 fine ounces of gold produced in the district passed through the hands of local gold buyers.

In the Grants Pass district a number of small operations in 1936 were reported. The total output of gold by small-scale miners selling through gold buyers exceeded 400 fine ounces.

In the Greenback district the largest lode-mine operation in 1936 was that of the Finley-McNeil Co. at the Greenback mine; the company employed an average of 10 men during the latter half of the year. Gold ore was treated in a 10-stamp mill, and 270 feet of development work were done. The largest mining operation in the district and one of the largest in the State was that of the Rogue River Gold Co., which operated an electric dredge of the connected-bucket type, having a capacity of 5,000 cubic yards per 24 hours; the company employed an average of 20 men at the dredge, exclusive of labor contracted to clear the land for mining. Carlson & Sandburg operated a dragline dredge on Coyote Creek for a short time toward the close of the year but later moved their equipment to California. Hydraulicking at the Blue Channel, Columbia, Forsythe, and H. K. Miller properties accounted for much of the remaining placer output of the district, and more than 150 fine ounces of gold produced by small-scale miners were sold through local gold buyers.

In the Illinois River district a number of small lode and placer operations accounted for the output in 1936; almost 300 fine ounces of gold were produced by very small operators, who sold their product through gold buyers.

In the Lower Applegate district the largest lode producer in 1936 was the Humdinger group; gold ore was mined and was treated in the 5-stamp amalgamation mill. The largest placer producers of the district were the Horsehead and the Oscar Creek mines. Over 100 fine ounces of gold were credited to small operators selling through local gold buyers.

In the Waldo district the Rainbow mine was the leading lode-gold producer in 1936. At the Esterly mine, formerly known as the Llano de Oro, gravels were hydraulicked. A stationary washing plant, to which gravel was delivered by power shovel and trucks, was worked at the Leonard mine during the spring months. At the

property of the Waldo Placer Mining Co. gold was recovered by hydraulicking from January to April. Almost 150 fine ounces of gold produced in the district by very small operators were sold through local gold buyers.

Lane County.—The only mining of importance in Lane County during 1936 was in the Bohemia district; the ore produced in the county was complex and contained gold, silver, copper, lead, and zinc. The Musick mine operated by the Minerals Exploration Co. was the leading mine in the district and one of the large mines of the State; most of the ore produced was treated by amalgamation and flotation, and both copper-lead and copper-lead-zinc concentrates were shipped for smelting. Smaller outputs were reported from the Evening Star and the Noonday mines. Construction and development work were carried on throughout the year at the property of the Bohemia Gold Mines, Inc.

Other counties.—The rest of the output from western Oregon in 1936 came from Lincoln and Linn Counties.

GOLD, SILVER, COPPER, AND LEAD IN SOUTH DAKOTA

(MINE REPORT)

By CHAS. W. HENDERSON and A. J. MARTIN

SUMMARY OUTLINE

Metal mines in South Dakota produced 586,353.40 fine ounces of gold and 144,448 fine ounces of silver in 1936 compared with 567,230.20 ounces of gold, 151,047 ounces of silver, and 7,000 pounds of recoverable lead in 1935. The production of gold in 1936 was the highest in any year on record and was exceeded in continental United States only by that of California; however, the producing area in South Dakota is much less than in California, comprising only parts of the three southwestern counties—Custer, Lawrence, and Pennington—in what is known as the Black Hills. As usual, the bulk of the output came from the famous Homestake mine, at Lead, Lawrence County, the largest producer of gold in the United States. Increased production by the Portland-Two Johns-Ajax group at Trojan and the Maitland group in the Maitland district, both also in Lawrence County, contributed substantially to the gain in the State total yield of gold. There were nine other producing lode mines in South Dakota in 1936. Placer operations yielded 346.80 fine ounces of gold in 1936 compared with 936.86 ounces in 1935.

The total production of gold, silver, copper, and lead (in terms of recovered metals) in South Dakota from the beginning of production in 1875 to the end of 1936, as compiled by Chas. W. Henderson, has been 17,055,717 fine ounces of gold, 8,530,474 fine ounces of silver, 195,691 pounds of copper, and 575,313 pounds of lead.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the prices given in the table that follows. Gold in 1932 is figured at \$20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1837, to January 31, 1934; in 1933 at \$25.56 and in 1934 at \$34.95 per ounce, the yearly average weighted United States Government price [1]; and in 1935 and 1936 at \$35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1932 and 1933 is the average New York price for bar silver; in 1934, the Treasury buying price (\$0.64646464+ per ounce) for newly mined silver; and in 1935 and 1936, the yearly average weighted Treasury buying price for newly mined silver. The copper, lead, and zinc prices are weighted yearly averages of all grades of primary metal sold by producers.

[1] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at \$35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Prices of gold, silver, copper, lead, and zinc, 1932–36

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[1] $20.67+	$0.282	$0.063	$0.030	$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050

[1] $20.671835. [2] $0.64646464.

Mine production of gold, silver, and lead in South Dakota, 1932–36, in terms of recovered metals [1]

Year	Mines producing			Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)		Lead		Total value
	Lode	Placer	Total		Fine ounces	Value	Fine ounces	Value	Pounds	Value	
1932	8	217	225	1,409,893	480,337.58	$9,929,459	126,195	$35,587	7,000	$210	$9,965,256
1933	4	215	219	1,432,555	512,403.77	13,097,040	125,417	43,896			13,140,936
1934	8	258	266	1,520,669	486,118.97	16,989,858	99,741	64,479			17,054,337
1935	15	199	214	1,487,235	567,230.20	19,853,057	151,047	108,565	7,000	280	19,961,902
1936	12	130	142	1,549,146	586,353.40	20,522,369	144,448	111,875			20,634,244

[1] For total production of gold and silver in South Dakota, by years, see Mineral Resources, 1913, pt. I, p. 42; Mineral Resources, 1922, pt. I, p. 194; and subsequent volumes of Mineral Resources and Minerals Yearbook.

Gold and silver produced at placer mines in South Dakota, 1932–36, in terms of recovered metals

Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value	
1932	1,095.16	$22,639	85	$24	$22,663
1933	1,269.75	32,455	97	34	32,489
1934	1,080.20	37,753	85	55	37,808
1935	936.86	32,790	103	74	32,864
1936	346.80	12,138	31	24	12,162

Gold and silver produced at placer mines in South Dakota in 1936, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Dry-land dredges [1]		Total	
	Gold	Silver	Gold	Silver	Gold	Silver
Custer	14.96		125.33	9	140.29	9
Lawrence	54.99	7	14.41	2	69.40	9
Pennington	137.11	13			137.11	13
	207.06	20	139.74	11	346.80	31
Total, 1935	391.35	35	545.51	68	936.86	103

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

MINING AND METALLURGIC INDUSTRY

All the ores mined in South Dakota in 1936 were dry gold ores, comprising 1,383,929 tons treated by amalgamation followed by cyanidation of sands and slimes, 155,652 tons by cyanidation only or by roasting followed by cyanidation, 9,521 tons by amalgamation only, and 44 tons (yielding 104.69 ounces of gold and 21 ounces of silver) shipped crude to smelters. Operating details at both lode and placer mines are given in the following review by counties.

METALLURGIC RECOVERY

Gold and silver bullion produced at mills in South Dakota by amalgamation, 1932–36

Year	Ore treated	Gold in bullion	Silver in bullion	Quicksilver used
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
1932	1,402,275	310,637.81	72,639	7,633
1933	1,432,555	328,449.02	71,985	29,410
1934	1,441,052	310,941.73	58,086	9,663
1935	1,382,774	335,553.97	75,858	15,550
1936	1,393,450	330,052.08	66,585	15,093

Gold and silver bullion produced at mills in South Dakota by cyanidation, 1932–36

Year	Material treated			Gold in bullion product	Silver in bullion product	Sodium cyanide used [1]
	Crude ore	Sands and slimes	Total			
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*
1932		1,396,330	1,396,330	168,561.00	50,166	437,773
1933		1,430,738	1,430,738	182,685.00	53,335	447,172
1934	79,617	1,432,045	1,511,662	174,097.04	41,570	519,724
1935	104,431	1,380,128	1,484,559	230,653.47	73,558	686,625
1936	155,652	1,382,676	1,538,328	255,849.83	77,811	[2] 749,923

[1] In terms of 96- to 98-percent strength.
[2] Actually 1,495,883 pounds of cyanamid (49-percent strength) and 1,981 pounds of sodium cyanide (96- to 98-percent strength); cyanamid reduced to equivalent of 96- to 98-percent strength to conform with earlier use of figures for high-strength NaCN and KCN.

REVIEW BY COUNTIES

CUSTER COUNTY

Mine production of gold and silver in Custer County, S. Dak., 1932–36, in terms of recovered metals

Year	Mines producing		Ore	Gold (lode and placer)		Silver (lode and placer)	Total value
	Lode	Placer					
			Short tons	*Fine ounces*		*Fine ounces*	
1932		80		697.81	$14,425	50	$14,439
1933		52		893.63	22,841	57	22,861
1934		44		528.81	18,482	34	18,504
1935	2	34	120	468.85	16,410	35	16,435
1936		9		140.29	4,910	9	4,917

Dr. C. Palmer operated equipment comprising a dragline, portable trommel screen, and sluices from July 15 to November 30, 1936, at the Kidwell property on French Creek one-half mile west of Custer;

3,000 cubic yards of overburden were removed and 1,500 yards of gravel treated. John Ross operated a three-quarter-yard dragline excavator, portable revolving screen, and sluice box intermittently from May 15 to July 5 at the Dickey placer 5 miles northwest of Custer; between 6,000 and 8,000 cubic yards of gravel were treated. These two operators produced most of the output of gold from Custer County in 1936; the remainder was recovered on French Creek by individuals with sluices, rockers, and pans. Fewer persons tried to earn a living by small-scale placer mining in the county in 1936 than in any year since 1930.

No production was made from lode mines in Custer County in 1936.

LAWRENCE COUNTY

Mine production of gold, silver, and lead in Lawrence County, S. Dak., 1932-36, in terms of recovered metals

Year	Mines producing		Ore	Gold (lode and placer)		Silver (lode and placer)	Lead	Total value
	Lode	Placer						
			Short tons	*Fine ounces*		*Fine ounces*	*Pounds*	
1932	3	17	1,409,211	479,300.90	$9,908,029	126,103	7,000	$9,943,800
1933	3	21	1,432,285	511,289.36	13,068,556	125,340		13,112,425
1934	4	43	1,520,578	485,223.18	16,958,550	99,680		17,022,990
1935	6	30	1,486,274	566,194.66	19,816,813	150,940	7,000	19,925,581
1936	5	11	1,539,409	585,379.74	20,488,291	144,253		20,600,015

Homestake mine.—The Homestake mine and mills were operated continuously in 1936. The new 5,000-foot, three-compartment, 13- by 19-foot Ross shaft, begun in December 1932 and first placed in service to the 2,750-foot level (2,900 feet below the skip dump) in November 1934, had been completed and steel-timbered to 30 feet below the 3,800-foot level by the end of 1936 and was operated to the 3,800-foot level. Other development work done in the mine during 1936 comprised 24,594 feet of drifts, 11,759 feet of raises, and 10,215 feet of diamond drilling. Part of the ore produced during the year was hoisted through the Ellison shaft, where the primary crushing plant is underground; ore handled through the Ross shaft was crushed in the new crushing plant on the surface at the shaft.

For treatment the ore is moved by a rail tramway from the hoists to the South mill, which has a capacity of 3,900 tons per 24 hours. Here the ore is further reduced by stamps and fed to rod mills in closed circuit with Clark-Todd amalgamators for primary grinding and to ball mills and pebble mills in closed circuit with Clark-Todd amalgamators for secondary grinding. The copper amalgamation plates, for many years an integral part of the mill equipment, have been gradually replaced by the Clark-Todd amalgamators, but a few were still in use in 1936. Classification is done partly in the South mill but is finished in cyanide sand plant No. 1 and cyanide sand plant No. 3. In plant No. 3 part of the tailings from the South mill are classified and further ground in ball mills in closed circuit with Clark-Todd amalgamators. The sands are treated by cyanide leaching, and the slimes are thickened and sent to the slime plant at Deadwood for further treatment. In plant No. 1 a partly classified sand portion of the tailings from the South mill is separated by cone classification

into sand and slime fractions. In this plant the sands are leached, and the solutions from both this plant and the No. 3 plant are precipitated. Slimes are piped to the slime plant at Deadwood, which accomplishes cyanidation of the slimes from both plants. Precipitation is by the Merrill-Crowe process. Silver is parted from the gold in the company refinery, and virtually pure metals are shipped to the mint.

Ore from the Homestake mine to the company mills totaled 1,383,-929 tons in 1936, an increase of 4,766 tons over 1935, and revenue from the sale of gold-silver bullion and a small quantity of assay laboratory slag was $19,506,534.78—$315,521.59 more than in 1935. Dividends paid in 1936 were $9,041,760. From 1876 to 1936, inclusive, this mine yielded bullion and concentrates that brought a cash return of $321,508,038 after freight, express, insurance, mint, and smelter charges were deducted; the company has paid $97,062,202 in dividends.

The annual report of the general manager of the Homestake Mining Co. for the year ended December 31, 1936, says:

Operations in all departments during 1936 were normal. Production from the mine was slightly larger than in the preceding year and gross income for gold and silver produced set a new record.

The mine, treatment plants, and other surface plants are in excellent condition. It is expected that production for 1937 will be approximately the same as in 1936.

There are 311,921 tons of broken ore remaining in shrinkage stopes.

The reserve of developed ore is 15,270,968 tons.

The Ross shaft is completed and steel installed to 30 feet below the 3,800-foot level. The large cage was operated to that level on the last day of the year.

The No. 2 winze was completed to the 4,100-foot level with a 34-foot sump. Main drifts on the 4,100-foot level were driven 2,161 feet.

The Ross compressor plant, to replace that at the B & M shaft and to provide added capacity, is nearly completed. It will be in operation in February 1937.

Precipitation during 1936 was the lowest on record. As a result, power from the hydroplants was very low. But operations were not hampered because of ample capacity at the Kirk power station.

In the passing of Mr. B. C. Yates, general manager since 1918, everyone in the organization lost a good friend and wise leader. His loss is keenly felt.

Ore milled, receipts, and dividends, Homestake mine, 1932–36 [1]

Year	Ore milled	Receipts for bullion product		Dividends
		Total	Per ton	
	Short tons			
1932	1,401,593	$9,911,858.40	$7.0719	$2,662,296
1933	1,432,195	12,900,316.78	9.0074	3,767,400
1934	1,440,692	16,515,684.14	11.4637	7,534,800
1935	1,379,163	19,191,013.19	13.9150	14,064,960
1936	1,383,929	19,506,534.78	14.0950	9,041,760

[1] From 1876 to 1936, inclusive, this mine yielded bullion and concentrates which brought $321,508,038 and paid $97,062,202 in dividends.

Other mines.—At Trojan the Bald Mountain Mining Co. operated its all-sliming cyanide plant at an average daily rate of 306 tons for 365 days in 1936 on ore extracted from its Portland-Two Johns-Ajax-Alaska-Dakota group and some custom ore. The ore is loaded into 1½-ton cars in the mine and raised by rail tramway through an incline to the surface; the cars then travel by gravity downgrade to the mill 4,200 feet from the mine. The company did 1,875 feet of development work in the mine during the year and completed the installation of three additional thickeners and a vacuum pump to raise the capacity of the mill from 250 to 325 tons per 24 hours.

In the Maitland district the Canyon Corporation operated the Maitland mine and 110-ton roasting and cyanidation mill continuously in 1936. The mill treated an average of 102 tons daily for 365 days. The ores are refractory sulphide ores, commonly known as blue ores—gold in a siliceous dolomite gangue with pyrite and some undetermined arsenic mineral. The mine is opened by a vertical shaft with stations at the 220- and 320-foot levels. Development work done in 1936 totaled 2,348 feet. Additions to the mill in 1936 included a 30-foot Dorr thickener, 22-foot agitator, and Dorrco pump.

At the Clover Leaf property in the Bear Butte district, the Anaconda Mining & Milling Co. completed the unwatering of the seventh level and operated a section of the old 60-stamp mill intermittently after May 1936. The ore was amalgamated on plates, and the tailings were stored for treatment in a proposed new cyanide unit, on which construction was begun before the end of the year.

In the Two Bit district, the Monarch mine, which had been a continuous small-scale producer since 1932, was closed in September 1936 because the operator ran out of ore. The mine is equipped with a 25-ton cyanide mill.

Placers in Lawrence County yielded 69.40 fine ounces of gold in 1936, part of which was recovered during a short working period by an operator on Whitewood Gulch using a dragline and sluices. Small individual operators reported a shortage of water for panning and sluicing.

Activities reported at nonproducing properties in Lawrence County in 1936 were development work and repairs at the Gilt Edge, Minnesota, and Golden Crest and sampling at the Golden Reward.

Considerable diamond drilling was done by the Black Hills Mining Corporation, optionee of a property about 4 miles southeast of Deadwood.

PENNINGTON COUNTY

Mine production of gold and silver in Pennington County, S. Dak., 1932–36, in terms of recovered metals

Year	Mines producing		Ore	Gold (lode and placer)		Silver (lode and placer)	Total value
	Lode	Placer					
			Short tons	*Fine ounces*		*Fine ounces*	
1932	5	120	682	338.87	$7,005	42	$7,017
1933	1	142	270	220.78	5,643	20	5,650
1934	4	171	91	366.98	12,826	27	12,843
1935	7	135	841	566.69	19,834	72	19,886
1936	7	110	9,737	833.37	29,168	186	29,312

In 1936 the King of the West Mining Co. completed a 50-ton all-slime cyanide semicountercurrent decantation plant at its King of the West mine on the head of Smith Gulch about 4½ miles southwest of Rochford. The mine is opened by a vertical shaft 160 feet deep, with levels at 75 and 150 feet, and by 947 feet of drifts and 375 feet of raises; in addition, 3,440 feet of diamond drilling have been done on the property. The ore is siliceous, carrying gold and a little silver associated with pyrite and arsenopyrite. The mine was operated all of 1936; the mill was started July 22 and after completion of test runs treated a daily average of 38 tons for the remainder of the year. In

November a concentrating jig and an amalgam barrel were added to the mill equipment. Bullion recovered was shipped to the Denver Mint.

The Empire Gold Mines, Inc., did 800 feet of drifting and crosscutting in 1936 at the Golden Slipper mine in the Hill City district and installed additional mill equipment consisting of a Denver "Sub-A" 6-cell unit, Denver mineral jig, Akins classifier, Wilfley table, and amalgamation barrel; a crusher and ball mill had previously been installed. Operations during the year were confined mostly to development work and remodeling of the mill, but several lots of amalgamation bullion recovered during testing of the equipment were shipped to the mint and some high-grade ore was sold to smelters. The Bothwell mine near Rochford was operated under lease in 1936 by the Driskill Mining Co. from January 1 to July 6 and by L. F. Thorne from July 7 to September 5. The ore was treated in a 10-stamp amalgamation mill using steam for power. Gold-silver bullion recovered was shipped to the Denver Mint. A 25-ton mill equipped with 10 stamps, amalgamation plates, and table was installed at the Marigold property in 1936, and test runs were made on ore taken from an open-cut. At the Western Bell claim, equipped with a 4-ton stamp mill, the two owners continued intermittent small-scale operations. Small lots of amalgamation bullion were recovered at the Shellerud property and Doctor No. 2 claim, and one lot of gold ore was shipped from the Nancy Lee to the Golden Cycle mill at Colorado Springs, Colo.

At the Union Hill group 3½ miles northwest of Hill City, the Ceko Mining Co. began construction of a 75-ton flotation mill in October 1936. Other properties under development in Pennington County included the Bismarck group, Joe Dollar, Holy Terror, and Three Jay—all in the Keystone district.

Sluicing operations in 1936, chiefly on Castle, Slate, Rapid, and Spring Creeks, produced small lots of placer gold, most of which was sold to bullion buyers or traded for groceries at stores in the vicinity.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN TEXAS

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

Mines in Texas produced, in terms of recovered metals, 613 fine ounces of gold, 1,361,459 fine ounces of silver, 53,000 pounds of copper, and 935,000 pounds of lead in 1936 compared with 518 ounces of gold, 1,000,960 ounces of silver, 28,000 pounds of copper, and 1,043,000 pounds of lead in 1935. In 1936 the Presidio silver mine of the American Metal Co. in Presidio County produced the bulk of the State gold, silver, and lead; most of the copper was contained in silver ore shipped from the Plata Verde mine in Hudspeth County, a substantial producer of silver during the year. There were three other producing mines and prospects in Culberson and Hudspeth Counties in 1936, but their aggregate output was not large.

The total production of gold, silver, copper, lead, and zinc in Texas (in terms of recovered metals) from the beginning of production in 1885 to the end of 1936, according to Henderson,[1] has been 6,098 fine ounces of gold, 25,990,966 fine ounces of silver, 1,419,960 pounds of copper, 6,478,126 pounds of lead, and 1,488,474 pounds of zinc.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the prices given in the table that follows. Gold in 1932 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1837, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95 per ounce, the yearly average weighted United States Government price[2]; and in 1935 and 1936 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1932 and 1933 is the average New York price for bar silver; in 1934, the Treasury buying price ($0.64646464+ per ounce) for newly mined silver; and in 1935 and 1936, the yearly average weighted Treasury buying price for newly mined silver. The copper, lead, and zinc prices are weighted yearly averages of all grades of primary metal sold by producers.

[1] For production from 1885 to 1927 and prices used in calculating values see Mineral Resources, 1927, pt. I, pp. 477–478. *See also* Mineral Resources, 1914, pt. 1, p. 236.

[2] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Prices of gold, silver, copper, lead, and zinc, 1932–36

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[1] $20.67+	$0.282	$0.063	$0.030	$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050

[1] $20.671835. [2] $0.64646464.

MINE PRODUCTION

Mine production of gold, silver, copper, and lead in Texas, 1932–36, in terms of recovered metals

Year	Ore (short tons)	Gold		Silver		Copper		Lead		Total value
		Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	
1932	185	8.66	$179	1,422	$401	7,000	$441	34,000	$1,020	$2,041
1933	63			160	56	2,000	128	6,000	222	406
1934	47,680	358.74	12,538	854,442	552,367	29,000	2,320	719,000	26,603	593,828
1935	72,222	518.00	18,130	1,000,960	719,440	28,000	2,324	1,043,000	41,720	781,614
1936	104,990	613.00	21,455	1,361,459	1,054,450	53,000	4,876	935,000	43,010	1,123,791

Mine production of gold, silver, copper, and lead in Texas in 1936, by counties, in terms of recovered metals

County	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Culberson and Hudspeth	4	6,491	12.43	119,854	53,000	20,000
Presidio	1	98,499	600.57	1,241,605		915,000
	5	104,990	613.00	1,361,459	53,000	935,000
Total, 1935	14	72,222	518.00	1,000,960	28,000	1,043,000

SMELTING AND REFINING PLANTS IN TEXAS

Custom smelters of the American Smelting & Refining Co. in Texas furnished a market for ores and concentrates from eight western States in 1936. The copper and lead plants at El Paso treated gold, silver, copper, and lead ores and concentrates from Arizona, New Mexico, and Texas and lead ore in bond from Mexico. At the end of 1936 the copper works consisted of two reverberatories, with a total annual capacity of 600,000 tons of ore, and three converters; the lead plant was equipped with three furnaces having a total annual capacity of 200,000 tons. Both plants were operated intermittently in 1936, but increasing prices for base metals late in the year permitted continuous operation of both plants to be resumed early in 1937. The reopening in January 1937 of the Chino copper mine (idle since October 1934) at Santa Rita, N. Mex., and its large concentration mill at Hurley, N. Mex., was the most potent factor affecting the operations at the copper plant, where Chino copper concentrates are treated on toll. Natural gas for fuel was introduced in these plants

in 1930.[3] In 1936 the American Smelting & Refining Co. natural-gas-retort zinc-smelting plant at Amarillo treated zinc ores and concentrates from Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, and Utah. Data on the number of retorts in service in 1936 are not available, but figures published in Minerals Yearbook, 1935, page 113, show that the plant was equipped with 6,400 regular horizontal retorts in 1934.

In October 1936 a new natural-gas, horizontal-retort zinc smelter was completed and placed in operation 5 miles northeast of Dumas, Moore County, by the Illinois Zinc Co., which transferred its smelting activities from Peru, Ill., to take advantage of the low-cost natural gas available in Texas. During the period of operation in 1936 the company treated lead-free zinc concentrates from the Peru mill at Deming, N. Mex., operated by its subsidiary, the Peru Mining Co.

The Nichols electrolytic copper refinery at El Paso treats copper anodes produced at the Arizona smelters of the Phelps Dodge Corporation. The plant is operated by the Nichols Copper Co., which since 1934 has been a unit of the Phelps Dodge Corporation. The rated yearly capacity is 100,000 tons of anodes,[4] but the plant was not operated at full capacity all of 1936; however, it was being run at capacity in April 1937. Natural gas has been used for fuel since the beginning of operations the latter part of January 1930.

MINES REVIEW BY COUNTIES

Culberson and Hudspeth Counties.—The Plata Verde mine in Hudspeth County, in the Van Horn Mountains 14 miles by road southwest of Van Horn, yielded most of the ore shipped from Culberson and Hudspeth Counties (output combined) in 1936. The ore is a siliceous silver ore (chiefly chlorides) containing a little copper (malachite) and occurs in a shear zone in sandstone 30 feet wide, striking north and south and dipping 48° to 50° to the west. Several thousand tons of ore were shipped to the El Paso smelter in 1936 from an open stope 100 feet long and embracing the full 30-foot width of the zone. Other development work done at the mine in 1936 and to April 14, 1937, comprised deepening to 165 feet an existing 130-foot shaft north of the stope, crosscutting 58 feet, and raising 35 feet. South of the open stope is an old timbered incline extending 246 feet westward following the dip of the zone.

From the Hazel mine in Culberson County, in the south end of the Sierra Diablo Range 16 miles northwest of Van Horn, lessees shipped several cars of silver-copper ore obtained during intermittent gouging and clean-up operations. Development work was done at the Pecos mine in the same district, and surface work and surveying were done at the Black Shaft a few miles southwest of the Hazel but in the Allamoore district in Hudspeth County. The old Caruthers mine in Hudspeth County, near the highway 6 miles west of Sierra Blanca, was operated intermittently in 1936 and yielded between 50 and 100 tons of lead-gold-silver smelting ore; the other output from the Sierra Blanca district was one lot of silver-lead ore shipped from a prospect to the El Paso smelter.

[3] Marble, E. R., Natural-Gas Firing at El Paso Smelting Works: Min. and Met., October 1930, pp. 466–467.

[4] Robie, E. H., A Trip Through the New Nichols Copper Refinery at El Paso, Tex.: Eng. and Min. Jour., vol. 129, January 1930, pp. 5–10; Furnace and Casting Equipment of the New Nichols Refinery: Eng. and Min. Jour., vol. 129, January 1930, pp. 73–76.
Corwin, F. R., and Harloff, C. S., El Paso Refinery of the Nichols Copper Co.: Min. and Met., October 1930, pp. 459–465.

Presidio County.—The American Metal Co. of Texas operated its mill at Shafter for 365 days in 1936 at a daily average of 270 tons on ore from its Presidio mine. The mine is opened by two vertical shafts, one 400 feet and one 700 feet deep, and six levels and stopes aggregating about 50 miles of underground workings. In all, 7,406 feet of drifts, raises, and crosscuts were driven and 21,300 feet of diamond drilling done in 1936. The ore is found as a replacement of limestone beds and is oxidized, the principal mineral being silver chloride, associated with argentite, cerargyrite, galena, anglesite, and cerussite. The ore hoisted through the west shaft is transported by rail tramway to the east shaft, where it is transferred to a 1-mile aerial tramway which conveys the ore from both shafts to the mill. The ore is then crushed to one-quarter inch and is ground to minus 65-mesh in a ball mill. The product is tabled for lead recovery and cyanided for gold and silver recovery. The lead concentrates and silver precipitates are shipped to the Carteret (N. J.) smelter. Electric power for the mill is obtained from a 1,200-horsepower Diesel plant.

Production of silver from the Presidio mine,[1] *1885–1936* [2]

Period	Mill heads treated (short tons)	Silver content of mill heads (ounces)		Recovery of silver	
		Per ton	Total	Percent	Ounces
1885–1912	450,000	25.84	11,628,000	81.68	9,497,750
1913–26	720,000	12.00	8,640,000	83.66	7,228,224
1927	48,190	22.87	1,102,105	91.41	[3] 1,007,434
1928	57,475	23.17	1,331,696	91.04	1,212,340
1929	54,644	19.74	1,078,673	90.30	974,049
Total, 1885–1929	1,330,309	17.88	23,780,474	83.77	19,919,797
1930	24,985	16.09	401,926	88.79	[3] 356,854
1934	46,653	19.70	919,064	91.39	839,936
1935	70,166	15.87	1,113,686	87.84	978,303
1936	98,499	14.41	1,419,371	87.48	1,241,605
Total, 1885–1936	1,570,612	17.59	27,634,521	84.45	23,336,495

[1] Howbert, Van Dyne, and Gray, F. E., Milling Methods and Costs at Presidio Mine of the American Metal Co. of Texas: Am. Inst. Min. and Met. Eng. Tech. Pub. 368, 1930.
Howbert, Van Dyne, and Bosustow, Robert, Mining Methods and Costs at Presidio Mine of the American Metal Co. of Texas: Am. Inst. Min. and Met. Eng. Tech. Pub. 334, 1930.
[2] No production in 1931, 1932, and 1933.
[3] Revised figures furnished Apr. 11, 1937, from company records.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN UTAH

(MINE REPORT)

By C. N. Gerry and T. H. Miller

SUMMARY OUTLINE

The output of gold, silver, copper, lead, and zinc from Utah ores and gravels in 1936, in terms of recovered metals, was 223,440.00 fine ounces of gold, 9,997,645 fine ounces of silver, 252,434,000 pounds of copper, 139,772,000 pounds of lead, and 72,384,000 pounds of zinc. This output compares with a production in 1935 of 184,759.80 ounces of gold, 9,206,329 ounces of silver, 129,515,217 pounds of copper, 127,019,175 pounds of lead, and 62,213,614 pounds of zinc. There were 171 lode mines and 28 placers operating in 1936 compared with 203 lode mines and 31 placers in 1935.

Since 1864 the output of the five metals in Utah has been as follows: Gold, 7,545,095 fine ounces; silver, 624,421,861 fine ounces; copper, 5,323,628,251 pounds; lead, 7,579,535,840 pounds; and zinc, 1,175,268,050 pounds. The total value of this output has been $1,918,311,009.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the prices given in the table that follows. Gold in 1932 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1837, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95 per ounce, the yearly average weighted United States Government price[1]; and in 1935 and 1936 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1932 and 1933 is the average New York price for bar silver; in 1934, the Treasury buying price ($0.64646464+ per ounce) for newly mined silver; and in 1935 and 1936, the yearly average weighted Treasury buying price for newly mined silver. The copper, lead, and zinc prices are weighted yearly averages of all grades of primary metal sold by producers.

[1] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Prices of gold, silver, copper, lead, and zinc, 1932–36

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[1] $20.67+	$0.282	$0.063	$0.030	$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050

[1] $20.671835. [2] $0.64646464.

Mine production of gold, silver, copper, lead, and zinc in Utah, 1932–36, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1932	86	19	3,768,542	135,256.35	$2,795,997	6,962,097	$1,963,311
1933	121	21	4,116,935	109,129.55	2,789,351	5,669,197	1,984,219
1934	190	28	5,076,735	136,581.52	4,773,524	7,111,417	4,597,280
1935	203	31	7,771,596	184,759.80	6,466,593	9,206,329	6,617,049
1936	171	28	14,997,892	223,444.00	7,820,540	9,997,645	7,743,176

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1932	64,964,111	$4,092,739	125,552,966	$3,766,589	59,331,888	$1,779,957	$14,398,593
1933	73,583,130	4,709,320	117,376,556	4,342,933	59,489,193	2,498,546	16,324,369
1934	86,024,925	6,881,994	116,153,945	4,297,696	56,396,279	2,425,040	22,975,534
1935	129,515,217	10,749,763	127,019,175	5,080,767	62,213,614	2,737,399	31,651,571
1936	252,434,000	23,223,928	139,772,000	6,429,512	72,384,000	3,619,200	48,836,356

Gold.—The output of recoverable gold in Utah was 223,444.00 fine ounces in 1936 compared with 184,759.80 ounces in 1935 and 136,581.52 ounces in 1934. The average annual output for the decade 1927–36 has been 184,325.46 fine ounces. Most of the increase in gold in 1936 over 1935 came from the Bingham or West Mountain district, chiefly from copper ore. Copper ore yielded 52.49 percent of the total gold in 1936, siliceous ore 35.96 percent, lead-zinc ore 8.83 percent, and lead ore 2.64 percent. Most of the gold from copper ore came from the Utah Copper Co. mine at Bingham which was, as usual, the largest producer of gold in Utah. Of the total gold output in 1936 concentrates of all classes yielded 61.53 percent, crude ore of smelting grade 30.41 percent, and bullion from ore to gold and silver mills 7.99 percent; placer mines yielded only 161.40 ounces.

Silver.—The output of recoverable silver in Utah was 9,997,645 fine ounces in 1936 compared with 9,206,329 ounces in 1935 and 7,111,417 ounces in 1934. The average annual output for the decade 1927–36 has been 11,363,927 fine ounces. The output of silver from each of the three principal mining areas in Utah (Bingham, Park City, and Tintic) increased in 1936. Most of the increase in silver in 1936 came from lead-zinc ore, the source of 46.91 percent of the total. Of the total silver siliceous ore yielded 30.91 percent, lead ore 11.56 percent, and copper ore 10.62 percent. Concentrates yielded 57.50 percent of the silver in 1936 and crude ore smelted 42.44 percent.

Copper.—The output of recoverable copper in Utah was 252,434,000 pounds in 1936 compared with 129,515,217 pounds in 1935 and 86,024,925 pounds in 1934. The output of copper in 1936 was the largest since 1929, when 318,282,523 pounds were produced; it was considerably larger than the average annual output (180,673,515 pounds) for the decade 1927–36. Almost all of the increase in copper in both 1935 and 1936 came from the Utah Copper mine at Bingham; the open-pit mine and mills (both Magna and Arthur) were operating at capacity during the last quarter of 1936. Copper ore (including copper from mine-water precipitates) yielded 95.89 percent of the total copper in 1936; most of the remainder came from siliceous ore and lead-zinc ore.

Lead.—The output of recoverable lead in Utah was 139,772,000 pounds in 1936 compared with 127,019,175 pounds in 1935 and 116,153,945 pounds in 1934. The output in 1936 was considerably less than the average annual output (190,844,237 pounds) for the decade 1927–36. The output of lead decreased nearly 7,700,000 pounds in the Bingham district in 1936 but increased in the Park City region, the Tintic district, and the Ophir-Rush Valley section in Tooele County. Lead-zinc ore yielded 75.28 percent of the lead in 1936, lead ore 20.15 percent, and siliceous ore 4.55 percent. Concentrates yielded 75.28 percent of the total lead, and crude ore smelted yielded the remainder.

Zinc.—The output of recoverable zinc in Utah was 72,384,000 pounds in 1936 compared with 62,213,614 pounds in 1935 and 56,396,279 pounds in 1934. The average annual output for the decade 1927–36 has been 76,944,926 pounds. Most of the increase in zinc in 1936 came from the Park City region and was due to increased production from the properties of Park Utah Consolidated Mines Co. All the zinc produced in Utah in 1936 came from zinc concentrates produced at flotation mills treating lead-zinc ore.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Utah, 1935–36, by counties, in terms of recovered metals

County	Mines producing			Ore (short tons)	Gold						Silver (lode and placer)	
					Lode		Placer		Total			
	Lode	Placer	Total		Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
1935												
Beaver	14		14	1,893	212.80	$7,448			212.80	$7,448	20,757	$14,919
Box Elder	8		8	917	313.40	10,969			313.40	10,969	64,946	46,680
Garfield	3	5	8	6	113.00	3,955	39.20	$1,372	152.20	5,327	875	629
Grand	2	12	14	15			145.60	5,096	145.60	5,096	1,045	751
Iron	9		9	2,313	679.40	23,779			679.40	23,779	13,415	9,642
Juab	34		34	89,063	17,226.80	602,938			17,226.80	602,938	786,503	565,299
Kane	1		1	3							32	23
Millard	5	5	10	1,130	490.80	17,178	45.00	1,575	535.80	18,753	1,109	797
Piute	11		11	16,669	4,276.60	149,681			4,276.60	149,681	24,939	17,925
Salt Lake	31	2	33	7,057,202	109,570.20	3,834,957	3.60	126	109,573.80	3,835,083	3,494,873	2,511,940
San Juan		3	3				17.00	595	17.00	595		
Sevier	2		2	22	10.60	371			10.60	371	281	202
Summit	7		7	112,716	2,765.60	96,796			2,765.60	96,796	1,408,288	1,012,207
Tooele	49		49	277,988	21,583.00	755,405			21,583.00	755,405	390,521	280,687
Uintah	1	4	5	10			5.40	189	5.40	189	25	18
Utah	18		18	117,406	22,019.40	770,679			22,019.40	770,679	1,906,752	1,370,478
Wasatch	7		7	94,238	5,240.60	183,421			5,240.60	183,421	1,091,968	784,852
Washington	1		1	5	1.80	63			1.80	63		
	203	31	234	7,771,596	184,504.00	6,457,640	255.80	8,953	184,759.80	6,466,593	9,206,329	6,617,049
1936												
Beaver	9		9	857	74.20	2,597			74.20	2,597	7,716	5,976
Box Elder	6		6	1,724	229.60	8,036			229.60	8,036	71,082	55,053
Garfield		5	5				6.80	238	6.80	238		
Grand		10	10				55.60	1,946	55.60	1,946	9	7
Iron	12		12	4,138	1,596.60	55,881			1,596.60	55,881	16,284	12,612
Juab	30		30	99,720	16,263.20	569,212			16,263.20	569,212	767,827	594,682
Millard	3	6	9	832	188.20	6,587	70.00	2,450	258.20	9,037	2,687	2,081
Piute	6		6	18,927	4,701.80	164,563			4,701.80	164,563	20,949	16,225
Salt Lake	28		28	14,261,546	149,736.00	5,240,760			149,736.00	5,240,760	3,804,071	2,946,253
San Juan	2	6	8	44			26.40	924	26.40	924	31	24
Summit	8		8	128,738	3,177.40	111,209			3,177.40	111,209	1,691,570	1,310,121
Tooele	42		42	247,553	18,828.20	658,987			18,828.20	658,987	546,634	423,368
Uintah	1	1	2	8			2.60	91	2.60	91	9	7
Utah	17		17	124,127	25,677.60	898,716			25,677.60	898,716	2,051,246	1,588,690
Wasatch	4		4	109,575	2,795.60	97,846			2,795.60	97,846	1,017,379	787,960
Washington	3		3	103	14.20	497			14.20	497	151	117
	171	28	199	14,997,892	223,282.60	7,814,891	161.40	5,649	223,444.00	7,820,540	9,997,645	7,743,176

County	Copper		Lead		Zinc		Total value		
	Pounds	Value	Pounds	Value	Pounds	Value	Lode	Placer	Lode and placer
1935									
Beaver	9,699	$805	205,475	$8,219	178,750	$7,865	$39,256		$39,256
Box Elder	422	35	4,200	168			57,852		57,852
Garfield	530	44	850	34			4,659	$1,375	6,034
Grand	687	57					793	5,111	5,904
Iron	253	21	3,700	148			33,590		33,590
Juab	702,325	58,293	3,098,400	123,936	30,546	1,344	1,351,810		1,351,810
Kane	843	70					93		93
Millard	22,313	1,852					19,822	1,580	21,402
Piute	7,615	632	35,475	1,419			169,657		169,657
Salt Lake	126,162,687	10,471,503	73,132,425	2,925,297	36,092,682	1,588,078	21,331,775	126	21,331,901
San Juan								595	595
Sevier							573		573
Summit	451,735	37,494	21,069,750	842,790	17,492,409	769,666	2,758,953		2,758,953
Tooele	730,602	60,640	15,224,375	608,975	6,295,909	277,020	1,982,727		1,982,727
Uintah	5,831	484					502	189	691
Utah	1,173,831	97,428	8,954,025	358,161	296,841	13,061	2,609,807		2,609,807
Wasatch	245,844	20,405	5,290,500	211,620	1,826,477	80,365	1,280,663		1,280,663
Washington							63		63
	129,515,217	10,749,763	127,019,175	5,080,767	62,213,614	2,737,399	31,642,595	8,976	31,651,571
1936									
Beaver	989	91	127,087	5,846			14,510		14,510
Box Elder	2,663	245	2,391	110			63,444		63,444
Garfield								238	238
Grand								1,953	1,953
Iron	185	17	717	33			68,543		68,543
Juab	717,641	66,023	3,240,587	149,067	96,400	4,820	1,383,804		1,383,804
Millard	25,728	2,367	3,565	164			11,196	2,453	13,649
Piute	8,000	736	25,261	1,162			182,686		182,686
Salt Lake	248,951,359	22,903,525	65,616,631	3,018,365	34.872,860	1,743,643	35,852,546		35,852,546
San Juan	12,707	1,169					1,193	924	2,117
Summit	470,967	43,329	23,426,261	1,077,608	16,450,340	822,517	3,364,784		3,364,784
Tooele	1,056,598	97,207	24,492,565	1,126,658	9,857,400	492,870	2,799,090		2,799,090
Uintah	3,804	350					357	91	448
Utah	1,061,424	97,651	11,420,739	525,354	400,180	20,009	3,130,420		3,130,420
Wasatch	87,576	8,057	11,416,196	525,145	10,706,820	535,341	1,954,349		1,954,349
Washington	34,359	3,161					3,775		3,775
	252,434,000	23,223,928	139,772,000	6,429,512	72,384,000	3,619,200	48,830,697	5,659	48,836,356

MINING INDUSTRY

The total value of the mine output of the five metals in Utah was $48,836,356 in 1936 compared with $31,651,571 in 1935 and $22,975,534 in 1934. The value of the 1936 output was larger than that in any year since 1929 and slightly larger than the average annual value ($46,068,160) for the decade 1927–36. The value of the copper output in 1936 increased $12,474,165 over 1935 and accounted for nearly 73 percent of the total increase in value for the State. The increase in copper output was due entirely to increased output of copper ore from Bingham by the Utah Copper Co. The substantial gains in the output of both lead and zinc in Utah in 1936 undoubtedly would have been considerably greater if the important producers of lead-zinc ore at both Park City and Bingham had not been closed by a metal-mine strike for more than 2 months during the last quarter of 1936.

ORE CLASSIFICATION

Ore sold or treated in Utah, 1935–36, with content in terms of recovered metals

Source	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
1935		*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold ore	59	413,063	62,459.78	680,409	3,714,048	1,632,708	
Dry gold and silver ore	23	151,295	22,645.80	875,447	2,315,556	3,086,645	
Dry silver ore	43	70,813	3,713.95	1,598,936	637,714	2,610,580	
	(1)	635,171	88,819.53	3,154,792	6,667,318	7,329,933	
Copper ore	17	6,530,569	67,689.79	602,852	119,043,058	9,692	
Lead ore	88	78,332	9,523.21	1,029,525	692,724	24,540,936	
Copper-lead ore	2	11	.40	366	1,012	3,500	
Lead-zinc ore	24	527,513	18,471.07	4,418,762	3,111,105	95,135,114	62,213,614
	(1)	7,136,425	95,684.47	6,051,505	122,847,899	119,689,242	62,213,614
Total, lode mines	[1] 203	7,771,596	184,504.00	9,206,297	129,515,217	127,019,175	62,213,614
Total, placers	31		255.80	32			
	[1] 234	7,771,596	184,759.80	9,206,329	129,515,217	127,019,175	62,213,614
1936							
Dry gold ore	44	350,484	58,447.71	691,900	3,972,143	1,014,973	
Dry gold and silver ore	14	122,675	16,979.76	789,904	1,721,869	2,694,368	
Dry silver ore	48	99,662	4,933.39	1,608,225	666,563	2,655,419	
	(1)	572,821	80,360.86	3,090,029	6,360,575	6,364,760	
Copper ore	9	13,774,589	117,287.20	1,061,547	242,056,998	21,973	
Lead ore	76	88,080	5,901.86	1,155,961	602,300	28,158,620	
Lead-zinc ore	25	562,402	19,732.68	4,690,095	3,414,127	105,226,647	72,384,000
	(1)	14,425,071	142,921.74	6,907,603	246,073,425	133,407,240	72,384,000
Total, lode mines	[1] 171	14,997,892	223,282.60	9,997,632	252,434,000	139,772,000	72,384,000
Total placers	28		161.40	13			
	[1] 199	14,997,892	223,444.00	9,997,645	252,434,000	139,772,000	72,384,000

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

Value of metals from ore sold or treated in Utah, 1935–36, by classes of ore

Class	Ore (short tons)	Gold	Silver	Copper	Lead	Zinc	Total
1935							
Dry gold ore	413,063	$2,186,093	$489,044	$308,266	$65,308		$3,048,711
Dry gold and silver ore	151,295	792,603	629,228	192,191	123,466		1,737,488
Dry silver ore	70,813	129,988	1,149,235	52,930	104,423		1,436,576
	635,171	3,108,684	2,267,507	553,387	293,197		6,222,775
Copper ore	6,530,569	2,369,143	433,300	9,880,574	388		12,683,405
Lead ore	78,332	333,312	739,971	57,496	981,637		2,112,416
Copper-lead ore	11	14	263	84	140		501
Lead-zinc ore	527,513	646,487	3,175,985	258,222	3,805,405	$2,737,399	10,623,498
	7,136,425	3,348,956	4,349,519	10,196,376	4,787,570	2,737,399	25,419,820
Total, lode mines	7,771,596	6,457,640	6,617,026	10,749,763	5,080,767	2,737,399	31,642,595
Total, placers		8,953	23				8,976
	7,771,596	6,466,593	6,617,049	10,749,763	5,080,767	2,737,399	31,651,571
1936							
Dry gold ore	350,484	2,045,670	535,876	365,437	46,689		2,993,672
Dry gold and silver ore	122,675	594,291	611,781	158,412	123,941		1,488,425
Dry silver ore	99,662	172,669	1,245,570	61,324	122,149		1,601,712
	572,821	2,812,630	2,393,227	585,173	292,779		6,083,809
Copper ore	13,774,589	4,105,052	822,168	22,269,244	1,011		27,197,475
Lead ore	88,080	206,565	895,292	55,411	1,295,296		2,452,564
Lead-zinc ore	562,402	690,644	3,632,479	314,100	4,840,426	3,619,200	13,096,849
	14,425,071	5,002,261	5,349,939	22,638,755	6,136,733	3,619,200	42,746,888
Total, lode mines	14,997,892	7,814,891	7,743,166	23,223,928	6,429,512	3,619,200	48,830,697
Total, placers		5,649	10				5,659
	14,997,892	7,820,540	7,743,176	23,223,928	6,429,512	3,619,200	48,836,356

Gold ore.—The output of gold ore in Utah was 350,484 tons (including 83,400 tons of old tailings) in 1936 compared with 413,063 tons (including 185,293 tons of old tailings) in 1935. All the old tailings in both 1935 and 1936 were from the Manning dumps and were re-treated by cyanidation. Most (175,936 tons) of the gold ore in 1936 was smelted. Gold and silver mills treated 90,968 tons of ore and 83,400 tons of old tailings. Eleven properties in Tooele County (chiefly in the Mercur district) produced 158,133 tons of gold ore and old tailings in 1936, and six properties in Salt Lake County (chiefly in the Bingham district) produced 101,760 tons of gold ore; most of the remainder came from the Tintic district.

Gold and silver ore.—Fourteen properties produced 122,675 tons of gold and silver ore in 1936 compared with 23 mines producing 151,295 tons in 1935. All the gold and silver ore produced in 1936 was shipped crude to smelters; more than half of it came from the Bingham district and nearly all the remainder came from the Tintic district.

Silver ore.—The output of siliceous silver ore was 99,662 tons in 1936 compared with 70,813 tons in 1935. About 67 percent of the total in 1936 came from 20 properties in the Tintic district, and most of the remainder came from the Park City region.

Copper ore.—The output of copper ore in Utah was 13,774,589 tons in 1936 compared with 6,530,569 tons in 1935 and 4,092,303 tons in 1934. All but 689 tons of the 1936 output came from the Utah Copper mine at Bingham. Metals recovered from copper ore were valued at $27,197,475, or 55.69 percent of the State total.

153336—37——34

Lead ore.—The output of lead ore was 88,080 tons in 1936 compared with 78,332 tons in 1935. The entire production in 1936 was shipped crude to smelters; nearly half of it came from Tooele County, chiefly from the Bluestone and Honerine mines at Bauer, and most of the remainder came from Utah and Salt Lake Counties.

Lead-zinc ore.—The output of lead-zinc ore was 562,402 tons in 1936 compared with 527,513 tons in 1935. The increase in lead-zinc ore in 1936 undoubtedly would have been much greater if the chief producers had not been closed for more than 2 months due to a labor strike. More than half the lead-zinc ore produced in 1936 came from the Bingham district, and most of the remainder came from Park City. Metals recovered from lead-zinc ore in 1936 were valued at $13,096,849, or 26.82 percent of the State total. All the lead-zinc ore produced in 1936 was treated at flotation concentrators at Midvale, Bauer, Tooele, and Park City.

Ore sold or treated in Utah, 1935–36, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	39	5.32	70	113	1,103	--------
Box Elder	98	89.60	64	12	1,700	--------
Garfield	1	107.91	821	8	49	--------
Iron	1,385	620.60	4,352	--------	--------	--------
Juab	25,424	8,324.39	132,140	149,178	124,178	--------
Millard	964	459.36	247	13,294	--------	--------
Piute	16,608	4,259.07	24,045	6,546	33,001	--------
Salt Lake	93,421	10,840.34	169,400	2,963,944	518,931	--------
Sevier	4	1.80	17	--------	--------	--------
Tooele	217,179	19,255.20	868	1,120	1,969	--------
Utah	57,935	18,494.39	348,385	579,833	951,777	--------
Washington	5	1.80	--------	--------	--------	--------
	413,063	62,459.78	680,409	3,714,048	1,632,708	--------
1936						
Box Elder	539	79.67	36	37	1,726	--------
Iron	3,902	1,565.42	11,036	--------	28	--------
Juab	32,186	7,321.93	146,213	217,836	264,841	--------
Millard	648	173.80	1,703	24,467	--------	--------
Piute	18,742	4,659.45	19,415	5,274	19,674	--------
Salt Lake	101,760	9,795.30	164,788	3,515,947	364,312	--------
Tooele	158,133	15,339.20	812	9,362	--------	--------
Utah	34,554	19,499.34	347,888	199,220	364,392	--------
Washington	20	13.60	9	--------	--------	--------
	350,484	58,447.71	691,900	3,972,143	1,014,973	--------

DRY GOLD AND SILVER ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
1935						
Beaver	785	122.70	5,125	2,900	17,221	--------
Iron	128	36.60	1,894	--------	--------	--------
Juab	37,087	6,938.56	251,228	408,784	399,046	--------
Piute	33	13.59	433	893	40	--------
Salt Lake	105,913	14,373.03	573,031	1,887,478	2,396,294	--------
Sevier	18	8.80	264	--------	--------	--------
Utah	6,591	1,082.12	39,078	11,404	243,307	--------
Wasatch	740	70.40	4,394	4,097	30,737	--------
	151,295	22,645.80	875,447	2,315,556	3,086,645	--------
1936						
Beaver	559	67.00	3,897	116	12,128	--------
Juab	35,472	6,442.51	270,212	357,178	557,403	--------
Millard	184	14.40	980	1,261	3,565	--------
Piute	185	42.35	1,534	2,726	5,587	--------
Salt Lake	69,535	8,102.66	407,147	1,125,819	1,757,387	--------
Utah	16,740	2,310.84	106,134	234,769	358,298	--------
	122,675	16,979.76	789,904	1,721,869	2,694,368	--------

Ore sold or treated in Utah, 1935–36, by counties, with content in terms of recovered metals—Continued

DRY SILVER ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	274	8.80	6,400			
Box Elder	817	223.80	64,833	410	1,825	
Grand	1		219			
Iron	800	22.20	7,169	253	3,700	
Juab	20,785	984.23	290,523	126,845	1,006,249	
Piute	28	3.94	461	176	2,434	
Salt Lake	313	13.73	2,777	2,391	10,827	
Summit	8,207	699.36	97,293	17,964	120,835	
Tooele	2,608	106.50	39,811	13,596	33,778	
Utah	34,891	1,569.18	1,051,407	474,939	1,376,021	
Wasatch	2,089	82.21	38,043	1,140	54,911	
	70,813	3,713.95	1,598,936	637,714	2,610,580	
1936						
Beaver	3	.16	20	173		
Box Elder	1,185	149.93	71,046	2,626	665	
Iron	236	31.18	5,248	185	689	
Juab	24,484	1,547.72	270,778	111,634	571,676	
Salt Lake	4,033	180.51	23,666	57,296	113,318	
Summit	19,029	565.37	250,855	10,302	275,594	
Tooele	2,887	95.86	42,149	57,340	134,211	
Utah	42,596	2,159.86	869,363	420,148	1,520,060	
Wasatch	5,209	202.80	75,100	6,859	39,206	
	99,662	4,933.39	1,608,225	666,563	2,655,419	

COPPER ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
1935						
Beaver	2	0.09	32	316	58	
Garfield	2	3.79	11	522		
Grand	14		805	687		
Kane	3		32	843		
Millard	166	31.44	855	9,019		
Salt Lake	6,530,196	67,648.32	598,097	119,012,275	1,015	
Tooele	176	6.15	2,995	13,565	8,619	
Uintah	10		25	5,831		
	6,530,569	67,689.79	602,852	119,043,058	9,692	
1936						
Salt Lake	13,774,115	117,275.60	1,056,776	241,986,065		
San Juan	44		31	12,707		
Tooele	339	11.00	4,589	20,063	21,973	
Uintah	8		9	3,804		
Washington	83	.60	142	34,359		
	13,774,589	117,287.20	1,061,547	242,056,998	21,973	

LEAD ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
1935						
Beaver	254	7.99	6,674	523	78,343	
Box Elder	2		49		675	
Garfield	3	1.30	39		801	
Juab	5,634	973.95	111,439	16,945	1,547,229	
Salt Lake	12,001	3,348.09	114,805	154,828	3,577,108	
Summit	111	5.90	3,886	1,240	60,840	
Tooele	31,623	1,638.08	205,415	266,982	9,498,001	
Utah	16,693	847.80	458,327	102,327	6,258,240	
Wasatch	12,011	2,700.10	128,891	149,879	3,519,699	
	78,332	9,523.21	1,029,525	692,724	24,540,936	
1936						
Beaver	295	7.04	3,799	700	114,959	
Juab	6,981	939.56	77,274	29,095	1,788,353	
Salt Lake	12,335	1,774.58	112,731	161,834	3,133,576	
Summit	766	36.97	18,146	7,317	155,178	
Tooele	43,773	2,018.14	259,456	219,911	14,663,291	
Utah	23,596	1,120.02	674,972	179,849	8,262,608	
Wasatch	334	5.55	9,583	3,594	40,660	
	88,080	5,901.86	1,155,961	602,300	28,158,620	

Ore sold or treated in Utah, 1935-36, by counties, with content in terms of recovered metals—Continued

COPPER-LEAD ORE[1]

County	Ore	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Salt Lake	11	0.40	366	1,012	3,500	
	11	.40	366	1,012	3,500	

[1] None produced in 1936.

LEAD-ZINC ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
1935						
Beaver	539	67.90	2,456	5,847	108,750	178,750
Juab	133	5.67	1,173	573	21,698	30,546
Salt Lake	315,347	13,346.29	2,036,397	2,140,759	66,624,750	36,092,682
Summit	104,398	2,060.34	1,307,109	432,531	20,888,075	17,492,409
Tooele	26,402	577.07	141,432	435,339	5,682,008	6,295,909
Utah	1,296	25.91	9,555	5,328	124,680	296,841
Wasatch	79,398	2,387.89	920,640	90,728	1,685,153	1,826,477
	527,513	18,471.07	4,418,762	3,111,105	95,135,114	62,213,614
1936						
Juab	597	11.48	3,350	1,898	58,314	96,400
Salt Lake	299,768	12,607.35	2,038,963	2,104,398	60,248,038	34,872,860
Summit	108,943	2,575.06	1,422,569	453,348	22,995,489	16,450,340
Tooele	42,421	1,364.00	239,628	749,922	9,673,090	9,857,400
Utah	6,641	587.54	52,889	27,438	915,386	400,180
Wasatch	104,032	2,587.25	932,696	77,123	11,336,330	10,706,820
	562,402	19,732.68	4,690,095	3,414,127	105,226,647	72,384,000

Zinc products (as marketed from Utah mines and mills) sold to smelters and electrolytic plants, 1935-36

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of ore and concentrates	Recovered zinc
1935		*Short tons*	*Pounds*	*Percent*	*Pounds*
Lead-zinc ore	Beaver and Salt Lake	281	134,883	24.00	107,867
Zinc concentrates	Beaver, Juab, Salt Lake, Summit, Tooele, Utah, and Wasatch.	64,808	69,433,851	53.57	62,105,747
		65,089	69,568,734	53.44	62,213,614
1936					
Zinc concentrates	Juab, Salt Lake, Summit, Tooele, Utah, and Wasatch.	73,458	80,426,142	54.74	72,384,000

METALLURGIC INDUSTRY

The 14,997,892 tons of ore (including 83,400 tons of old tailings) produced in 1936 in Utah comprised 174,368 tons (including all the old tailings) treated at gold and silver mills, 14,336,482 tons (95.59 percent) treated at concentration plants, and 487,042 tons shipped crude for smelting.

Of the seven gold and silver mills active in Utah in 1936, two used straight amalgamation, one amalgamation, cyanidation, and concentration, one cyanidation and concentration, and three straight cyanidation. The following table gives data covering operations at gold and silver mills in 1935 and 1936:

Mine production of metals from gold and silver mills in Utah, 1935–36, by counties, in terms of recovered metals

County	Ore treated (dry weight)	Recovered in bullion				Concentrates and recovered metal				
		Amalgamation		Cyanidation		Concentrates produced	Gold	Silver	Copper	Lead
		Gold	Silver	Gold	Silver					
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Box Elder	70	23.60	6			4	8.46	16	5	1,158
Iron	800			204.60	259					
Juab	60	13.00	8			3	17.58	14		
Piute	13,468	1,079.91	2,086	1,079.91	2,086	26	324.49	2,918		
Tooele	211,465			13,603.13	221					
Washington	5	1.80								
	225,868	1,118.31	2,100	14,887.64	2,566	33	350.53	2,948	5	1,158
1936										
Box Elder	500	41.14	9							
Iron	913			290.72	497					
Piute	16,200	1,445.05	2,378	1,445.05	2,377	27	228.20	1,693		
Tooele	156,735			14,618.40	124	88	193.00			
Washington	20	13.60	9							
	174,368	1,499.79	2,396	16,354.17	2,998	115	421.20	1,693		

Seven concentration plants (all using straight flotation) were in operation in Utah in 1936. Four treated lead-zinc ore, two copper ore, and one gold ore. The following tables give data on concentrates produced in Utah in 1935 and 1936:

Mine production of metals from concentrating mills in Utah, 1935–36, by counties, in terms of recovered metals

County	Ore milled	Concentrates and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	509	402	66.49	2,346	5,801	103,166	168,678
Iron	500	86	1.20	2,983	253	3,700	
Juab	133	55	5.67	1,173	573	21,698	30,546
Salt Lake	6,844,896	351,010	79,457.99	2,632,895	115,411,432	66,565,465	35,994,887
Summit	104,398	32,544	2,060.34	1,307,109	432,531	20,888,075	17,492,409
Tooele	26,914	17,392	600.17	145,023	435,339	5,878,622	6,295,909
Utah	1,296	577	25.91	9,555	5,328	124,680	296,841
Wasatch	79,398	4,122	2,387.89	920,640	90,728	1,685,153	1,826,477
	7,058,044	406,188	84,605.66	5,021,724	116,381,985	95,270,559	62,105,747
1936							
Iron	180	17	55.00	584			
Juab	597	194	11.48	3,350	1,898	58,314	96,400
Salt Lake	14,073,668	542,933	129,877.35	3,095,637	238,025,631	60,248,038	34,872,860
Summit	108,943	33,185	2,575.06	1,422,569	453,348	22,995,489	16,450,340
Tooele	42,421	29,550	1,364.00	239,628	749,922	9,673,090	9,857,400
Utah	6,641	1,979	587.54	52,889	27,438	915,386	400,180
Wasatch	104,032	29,367	2,587.25	932,696	77,123	11,336,330	10,706,820
	14,336,482	637,225	137,057.68	5,747,353	239,335,360	105,226,647	72,384,000

Gross metal content of Utah concentrates produced, 1935–36, by classes of concentrates

Class of concentrates	Concentrates produced (dry weight)	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	115	343.27	5,915	264	6,372	----------
Copper	178,238	66,111.70	596,498	116,773,890	----------	----------
Lead	83,449	10,755.70	3,776,073	2,651,060	91,721,558	10,558,135
Zinc	64,808	2,087.34	407,813	791,062	5,598,488	69,433,851
Iron (from lead-zinc ore)	79,611	5,658.18	238,373	547,065	3,680,399	6,745,717
	406,221	84,956.19	5,024,672	120,763,341	101,006,817	86,737,703
1936						
Dry and siliceous	132	476.20	2,277	----------	----------	----------
Copper	386,009	117,270.00	1,056,674	243,217,766	----------	----------
Lead	94,639	11,124.92	3,982,350	3,055,457	101,122,834	11,410,327
Zinc	73,458	2,625.88	429,901	813,006	6,215,284	80,426,142
Iron	83,102	5,981.88	277,844	593,538	4,034,468	5,691,001
	637,340	137,478.88	5,749,046	247,679,767	111,372,586	97,527,470

Mine production of metals from Utah concentrates, 1935–36, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	402	66.49	2,346	5,801	103,166	168,678
Box Elder	4	8.46	16	5	1,158	----------
Iron	86	1.20	2,983	253	3,700	----------
Juab	58	23.25	1,187	573	21,698	30,546
Piute	26	324.49	2,918	----------	----------	----------
Salt Lake	351,010	79,457.99	2,632,895	115,411,432	66,565,465	35,994,887
Summit	32,544	2,060.34	1,307,109	432,531	20,888,075	17,492,409
Tooele	17,392	600.17	145,023	435,339	5,878,622	6,295,909
Utah	577	25.91	9,555	5,328	124,680	296,841
Wasatch	4,122	2,387.89	920,640	90,728	1,685,153	1,826,477
	406,221	84,956.19	5,024,672	116,381,990	95,271,717	62,105,747
1936						
Iron	17	55.00	584	----------	----------	----------
Juab	194	11.48	3,350	1,898	58,314	96,400
Piute	27	228.20	1,693	----------	----------	----------
Salt Lake	542,933	129,877.35	3,095,637	238,025,631	60,248,038	34,872,860
Summit	33,185	2,575.06	1,422,569	453,348	22,995,489	16,450,340
Tooele	29,638	1,557.00	239,628	749,922	9,673,090	9,857,400
Utah	1,979	587.54	52,889	27,438	915,386	400,180
Wasatch	29,367	2,587.25	932,696	77,123	11,336,330	10,706,820
	637,340	137,478.88	5,749,046	239,335,360	105,226,647	72,384,000

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
1935						
Dry and siliceous	115	343.27	5,915	253	3,700	----------
Copper	178,238	66,111.70	596,498	113,270,673	----------	----------
Lead	83,449	10,755.70	3,776,073	1,840,282	87,826,903	----------
Zinc	64,808	2,087.34	407,813	746,702	5,303,577	62,105,747
Iron (from lead-zinc ore)	79,611	5,658.18	238,373	524,080	2,137,537	----------
	406,221	84,956.19	5,024,672	116,381,990	95,271,717	62,105,747
1936						
Dry and siliceous	132	476.20	2,277	----------	----------	----------
Copper	386,009	117,270.00	1,056,674	235,921,233	----------	----------
Lead	94,639	11,124.92	3,982,350	2,080,778	96,841,403	----------
Zinc	73,458	2,625.88	429,901	770,009	5,877,169	72,384,000
Iron	83,102	5,981.88	277,844	563,340	2,508,075	----------
	637,340	137,478.88	5,749,046	239,335,360	105,226,647	72,384,000

Nearly 82 percent of the crude ore of smelting grade in 1936 was siliceous ore, and nearly all the remainder was lead ore. The following tables give the contents of the crude ore smelted in 1935 and 1936, by classes and counties:

Gross metal content of Utah crude ore shipped to smelters, 1935–36, by classes of ore

Class of ore	Ore (dry weight)	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	407,655	72,413.05	3,127,601	6,873,364	13,056,079	
Copper	479	44.09	6,106	45,820	17,574	
Lead	77,798	9,499.43	1,025,788	845,826	25,386,468	
Lead-zinc	281	1.41	110	55	91,667	134,883
	486,213	81,957.98	4,159,605	7,765,065	38,551,788	134,883
1936						
Dry and siliceous	398,273	62,030.70	3,082,358	6,558,258	11,083,330	
Copper	689	17.20	4,873	98,373	27,931	
Lead	88,080	5,901.86	1,155,961	786,218	29,377,222	
	487,042	67,949.76	4,243,192	7,442,849	40,488,483	

Mine production of metals from Utah crude ore shipped to smelters, 1935–36, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	1,384	146.31	18,411	3,898	102,309	10,072
Box Elder	847	281.34	64,924	417	3,042	
Garfield	6	113.00	871	530	850	
Grand	15		1,024	687		
Iron	1,013	473.60	10,173			
Juab	88,634	17,169.95	784,216	700,341	3,071,936	
Kane	3		32	843		
Millard	1,130	490.80	1,102	22,313		
Piute	3,201	1,792.29	17,849	7,615	35,475	
Salt Lake	212,005	28,577.81	861,364	5,021,493	6,563,460	97,795
Sevier	22	10.60	281			
Summit	7,406	677.06	85,677	19,204	156,545	
Tooele	39,609	7,379.70	245,277	295,263	9,345,753	
Uintah	10		25	5,831		
Utah	116,110	21,993.49	1,897,197	1,168,503	8,829,345	
Wasatch	14,818	2,852.03	171,182	155,070	3,602,421	
	486,213	81,957.98	4,159,605	7,402,008	31,711,136	107,867
1936						
Beaver	857	74.20	7,716	989	127,087	
Box Elder	1,224	188.46	71,073	2,663	2,391	
Iron	3,045	1,250.88	15,203	185	717	
Juab	99,123	16,251.72	764,477	715,743	3,182,273	
Millard	832	188.20	2,683	25,728	3,565	
Piute	2,727	1,583.50	14,501	8,000	25,261	
Salt Lake	187,878	19,858.65	708,434	4,884,133	5,368,593	
San Juan	44		31	12,707		
Summit	19,795	602.34	269,001	17,619	430,772	
Tooele	48,397	2,652.80	306,882	306,676	14,819,475	
Uintah	8		9	3,804		
Utah	117,486	25,090.06	1,998,357	1,033,986	10,505,353	
Wasatch	5,543	208.35	84,683	10,453	79,866	
Washington	83	.60	142	34,359		
	487,042	67,949.76	4,243,192	7,057,045	34,545,353	

Mine production of metals from Utah crude ore shipped to smelters, 1935–36, in terms of recovered metals—Continued

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	407, 655	72, 413. 05	3, 127, 601	6, 665, 649	7, 295, 179	----------
Copper	479	44. 09	6, 106	43, 635	9, 692	----------
Lead	77, 798	9, 499. 43	1, 025, 788	692, 678	24, 341, 396	----------
Lead-zinc	281	1. 41	110	46	64, 869	107, 867
	486, 213	81, 957. 98	4, 159, 605	7, 402, 008	31, 711, 136	107, 867
1936						
Dry and siliceous	398, 273	62, 030. 70	3, 082, 358	6, 360, 575	6, 364, 760	----------
Copper	689	17. 20	4, 873	94, 170	21, 973	----------
Lead	88, 080	5, 901. 86	1, 155, 961	602, 300	28, 158, 620	----------
	487, 042	67, 949. 76	4, 243, 192	7, 057, 045	34, 545, 353	----------

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Utah, 1935–36, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
1935													
Beaver County:			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Beaver Lake	3		23	1.60		1.60	519		519	217	7,875		$762
Bradshaw	1		(1)	(1)		(1)	(1)		(1)				(1)
Lincoln	2		605	73.20		73.20	2,720		2,720	8,747	108,750	178,750	17,458
San Francisco	6		962	127.00		127.00	10,823		10,823	711	83,875		15,638
Star and North Star	2		29	2.20		2.20	295		295	24	4,975		490
Box Elder County:													
Ashbrook	1		(1)	(1)		(1)	(1)		(1)	(1)	(1)		(1)
Lucin	2		4				146		146	48	675		136
Park Valley	5		98	89.60		89.60	64		64	12	1,700		3,251
Garfield County:													
Colorado River		1			26.00	26.00		4	4				913
Henry Mountains	3		6	113.00		113.00	871		871	530	850		4,659
Imperial		4			13.20	13.20							462
Grand County:													
Colorado River		7			102.40	102.40		14	14				3,594
Dewey		2			35.00	35.00		7	7				1,230
La Sal [2]		1			2.60	2.60							91
Miners Basin	2	2	15		5.60	5.60	1,024		1,024	687			989
Iron County:													
Escalante	1		500	1.20		1.20	2,983		2,983	253	3,700		2,355
Stateline	8		1,813	678.20		678.20	10,432		10,432				31,235
Juab County:													
Detroit [3]	1		1,960	698.40		698.40	2,329		2,329	51,566			30,398
Fish Springs	4		57	2.20		2.20	4,213		4,213	36	36,650		4,574
North Tintic	1		4				14		14		2,975		129
Spring Creek	2		77	30.80		30.80	1,561		1,561	133	325		2,224
Tintic [4]	25		86,502	16,281.00		16,281.00	775.250		775,250	648.735	2,891,250	30,546	1,297,885
West Tintic	1		(1)	(1)		(1)	(1)		(1)	(1)	(1)		(1)
Kane County: Glendale	1		3				32		32	843			93
Millard County:													
Detroit [3]	5		1,130	490.80		490.80	1,102		1,102	22,313			19,822
Sawtooth Mountains		5			45.00	45.00		7	7				1,580

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Utah, 1935–36, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
1935—Continued			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Piute County:													
Gold Mountain	2		13,821	2,791.80		2,791.80	10,201		10,201				$105,045
Mount Baldy	1		2,616	1,331.80		1,331.80	13,216		13,216	6,121	30,325		57,833
Ohio	8		232	153.00		153.00	1,522		1,522	1,494	5,150		6,779
Salt Lake County:													
Big Cottonwood	5		1,290	67.20		67.20	19,911		19,911	21,362	421,500	97,795	39,599
Little Cottonwood	5		689	93.00		93.00	19,058		19,058	19,361	121,275	2,296	23,512
Smelter	2		11	.40		.40	366		366	1,012	3,500		501
West Mountain [5]	19	2	7,055,212	109,409.60	3.60	109,413.20	3,455,538		3,455,538	126,120,952	72,586,150	35,992,591	21,268,289
San Juan County:													
Blue Mountains		1			6.80	6.80							238
Colorado River		2			10.20	10.20							357
Sevier County: Henry	2		22	10.60		10.60	281		281				573
Summit County: Uintah	7		112,716	2,765.60		2,765.60	1,408,288		1,408,288	451,735	21,069,750	17,492,409	2,758,953
Tooele County:													
Camp Floyd	5		216,447	18,766.00		18,766.00	487		487				657,160
Clifton	7		1,786	63.40		63.40	13,081		13,081	19,241	386,925		28,695
Erickson	3		136	11.80		11.80	2,770		2,770	72	6,075		2,653
Free Coinage	2		76				462		462	12	52,975		2,452
Lakeside	3		237	.60		.60	249		249	313	78,950		3,384
Ophir	12		19,729	203.40		203.40	155,527		155,527	535,807	4,784,700	4,334,818	545,496
Rush Valley	12		38,908	2,073.40		2,073.40	217,575		217,575	175,145	9,913,675	1,961,091	726,323
West Mountain [5]	3		128	16.00		16.00	171		171	12	425		701
Willow Springs	2		541	448.40		448.40	199		199		650		15,863
Uintah County:													
Carbonate	1		10				25		25	5,831			502
Green River		4			5.40	5.40							189
Utah County:													
American Fork	8		3,059	776.40		776.40	17,273		17,273	58,337	179,900	296,841	64,688
Tintic [4]	10		114,347	21,243.00		21,243.00	1,889,479		1,889,479	1,115,494	8,774,125		2,545,119
Wasatch County:													
Blue Ledge	5		93,441	5,223.80		5,223.80	1,069,554		1,069,554	235,651	5,183,175	1,826,477	1,258,826
Snake Creek	2		797	16.80		16.80	22,414		22,414	10,193	107,325		21,837
Washington County: Bull Valley	1		5	1.80		1.80							63
Undistributed [6]			1,552	447.00		447.00	74,272		74,272	2,217	169,025		75,973
Total Utah	203	31	7,771,596	184,504.00	255.80	184,759.80	9,206,297	32	9,206,329	129,515,217	127,019,175	62,213,614	31,651,571

1936													
Beaver County:													
Beaver Lake	1		1				9		9	22			9
Bradshaw	2		7				235		235	54	5,783		453
Newton	1		25	5.00		5.00	430		430				508
San Francisco	4		818	68.00		68.00	6,971		6,971	913	119,978		13,382
Star and North Star	1		6	1.20		1.20	71		71		1,326		158
Box Elder County:													
Ashbrook	1		(1)	(1)		(1)	(1)		(1)	(1)	(1)		(1)
Park Valley	5		554	82.40		82.40	417		417	717	1,913		3,361
Garfield County: Imperial		5			6.80	6.80							238
Grand County:													
Colorado River		7			8.60	8.60							301
La Sal [3]		1			43.20	43.20		9	9				1,519
Miners Basin		2			3.80	3.80							133
Iron County: Stateline	12		4,138	1,596.60		1,596.60	16,284		16,284	185	717		68,543
Juab County:													
Detroit [3]	1		(1)	(1)		(1)	(1)		(1)	(1)			(1)
Fish Springs	4		47	1.40		1.40	2,936		2,936		27,674		3,596
Spring Creek	7		105	10.80		10.80	2,204		2,204	1,489	3,652		2,390
Tintic [4]	17		97,551	15,613.80		15,613.80	754,727		754,727	683,489	2,888,065	96,400	1,331,571
West Tintic	1		(1)	(1)		(1)	(1)		(1)	(1)	(1)		(1)
Millard County:													
Detroit [3]	2		648	173.80		173.80	1,703		1,703	24,467			9,653
Leamington	1		184	14.40		14.40	980		980	1,261	3,565		1,543
Sawtooth Mountains		6			70.00	70.00		4	4				2,453
Piute County:													
Gold Mountain	2		16,467	3,369.40		3,369.40	8,989		8,989				124,891
Mount Baldy	1		2,234	1,234.00		1,234.00	10,377		10,377	5,217	19,674		52,612
Ohio	3		226	98.40		98.40	1,583		1,583	2,783	5,587		5,183
Salt Lake County:													
Big Cottonwood	7		2,319	239.20		239.20	42,989		42,989	41,837	641,326	29,480	76,491
Little Cottonwood	5		571	47.60		47.60	7,543		7,543	3,761	72,522		11,190
West Mountain [5]	16		14,258,656	149,449.20		149,449.20	3,753,539		3,753,539	248,905,761	64,902,783	34,843,380	35,764,865
San Juan County:													
Colorado River		6			26.40	26.40							924
La Sal [3]	2		44				31		31	12,707			1,193
Summit County: Uintah	8		128,738	3,177.40		3,177.40	1,691,570		1,691,570	470,967	23,426,261	16,450,340	3,364,784
Tooele County:													
Camp Floyd	6		157,190	15,016.80		15,016.80	306		306				525,825
Clifton	11		2,114	343.20		343.20	9,215		9,215	30,848	215,391		31,895
Columbia	1		5				40		40		3,674		200
Erickson	1		544	26.60		26.60	13,561		13,561				11,434
Lakeside	3		610	2.60		2.60	838		838	304	161,739		8,208
Ophir	9		26,314	220.00		220.00	194,643		194,643	814,663	7,723,283	7,125,180	944,930
Rush Valley	9		60,645	3,159.80		3,159.80	327,765		327,765	210,522	16,381,891	2,732,220	1,273,993
West Mountain [5]	1		105	6.40		6.40	9		9				231
Willow Springs	1		26	52.80		52.80	257		257	261	6,587		2,374

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Utah, 1935–36, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
1936—Continued			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Uintah County:													
Carbonate	1		8				9		9	3,804			$357
Green River		1			2.60	2.60							91
Utah County:													
American Fork	7		1,680	400.40		400.40	18,652		18,652	32,272	183,500	143,480	47,044
Tintic [4]	10		122,447	25,277.20		25,277.20	2,032,594		2,032,594	1,029,152	11.237,239	256,700	3,083,376
Wasatch County:													
Blue Ledge	2		57,218	1,541.80		1,541.80	691,410		691,410	73,696	983,370	1,068,580	695,364
Snake Creek	2		52,357	1,253.80		1,253.80	325,969		325,969	8,880	10,432,826	9,638,240	1,258,985
Washington County:													
Bull Valley	1		20	13.60		13.60	9		9				483
Tutsagubet	2		83	.60		.60	142		142	34,359			3,292
Undistributed [6]			3,187	784.40		784.40	78,625		78,625	34,609	321,674		106,330
Total Utah	171	28	14,997,892	223,282.60	161.40	223,444.00	9,997,632	13	9,997,645	252,434,000	139,772,000	72,384,000	48,836,356

[1] Included under "Undistributed."
[2] La Sal district lies in both Grand and San Juan Counties.
[3] Detroit district lies in both Juab and Millard Counties.
[4] Tintic district lies in both Juab and Utah Counties.
[5] West Mountain district lies in both Salt Lake and Tooele Counties.
[6] Includes items entered as "([1])" above.

BEAVER COUNTY

Most of the output from Beaver County in 1935 was lead-zinc ore from the Lincoln mine and siliceous ore and lead ore from the Horn Silver mine. The Lincoln mine was inactive in 1936, but shipments from the Horn Silver mine continued; most of the remainder of the 1936 output was lead ore of smelting grade from the Frisco Silver-Lead property.

BOX ELDER COUNTY

Lessees continued operations at the Vipont mine in the Ashbrook district in 1935 and 1936 and made regular shipments of siliceous silver ore of smelting grade. Most of the remainder of the Box Elder County output in both 1935 and 1936 was gold ore from the Raft River and Susannah mines in the Park Valley district.

IRON COUNTY

The entire output from Iron County in 1936 was siliceous ore from the Stateline district northwest of Modena; it comprised gold ore from the Gold Coin mine treated by cyanidation, gold ore from the Jenny and Independence mines treated by flotation, and siliceous ore of smelting grade from the Cougar, Creole, Jenny, Johnny, Ophir, Gold Hill, Independence, Burro, Blue Rock, Jumbo, and Mona properties. In 1935 the county output consisted of silver ore from the Royal mine in the Escalante district, treated by flotation, and siliceous ore from several properties in the Stateline district, including the Gold Coin, Creole, Johnny, Ophir, Utah Spur, Exchange, and Badger mines.

JUAB COUNTY

Detroit district.—Siliceous gold ore of smelting grade containing considerable copper was shipped in both 1935 and 1936 from the Ibex mine northwest of Delta.

Fish Springs district.—Small lots of rich lead ore were shipped in both 1935 and 1936 from several properties, including the Emma, Utah, and Wilson mines.

Tintic district.—As indicated in the table that follows there were substantial increases in 1936 over 1935 in the output of gold, silver, lead, and zinc from mines in the Tintic district, including both Juab and Utah Counties; there was a slight decrease in the output of copper. Most of the increase was from mines in Utah County. The mines in both sections of the Tintic district are reviewed here.

Mine production of gold, silver, copper, lead, and zinc in Tintic district, Juab and Utah Counties, Utah, 1935–36, and total, 1869–1936, in terms of recovered metals

	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
1935		*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Juab County	25	86,502	16,281.00	775,250	648,735	2,891,250	30,546	$1,297,885
Utah County	10	114,347	21,243.00	1,889,479	1,115,494	8,774,125		2,545,119
	35	200,849	37,524.00	2,664,729	1,764,229	11,665,375	30,546	3,843,004
1936								
Juab County	17	97,551	15,613.80	754,727	683,489	2,888,065	96,400	1,331,571
Utah County	10	122,447	25,277.20	2,032,594	1,029,152	11,237,239	256,700	3,083,376
	27	219,998	40,891.00	2,787,321	1,712,641	14,125,304	353,100	4,414,947
Total, 1869–1936		(1)	2,307,310.16	236,992,208	224,406,044	1,709,249,502	32,639,062	351,802,948

[1] Figures not available.

Mine production of gold, silver, copper, lead, and zinc in Tintic district, Juab and Utah Counties, Utah, 1935–36, by classes of ore, in terms of recovered metals

Class of ore	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
1935		*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	32	179,016	35,905.04	2,103,766	1,649,245	4,089,468	
Lead	15	21,700	1,613.29	559,790	114,411	7,554,209	
Lead-zinc	2	133	5.67	1,173	573	21,698	30,546
	[1] 35	200,849	37,524.00	2,664,729	1,764,229	11,665,375	30,546
1936							
Dry and siliceous	26	183,914	38,585.54	2,003,596	1,488,989	3,623,879	
Lead	12	29,553	1,739.61	738,252	202,889	9,658,331	
Lead-zinc	3	6,531	565.85	45,473	20,763	843,094	353,100
	[1] 27	219,998	40,891.00	2,787,321	1,712,641	14,125,304	353,100

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

Producing mines in the Juab County section of the Tintic district in 1936 included the Centennial-Beck, Chief Consolidated, Dragon, Eagle & Blue Bell, Empire Star, Godiva, Iron Blossom, Mammoth, Plutus, Showers, Swansea, Silver Park, Gunderson, Victoria, and Yankee Girl; all of these properties except the Iron Blossom were also productive in 1935. Operations at the Mammoth mine were continuous in both 1935 and 1936; nearly 28,000 tons of ore were shipped for smelting in 1936 compared with about 23,000 tons in 1935, but the output of gold decreased about 1,500 ounces. Lessees continued shipments of siliceous ore and lead ore in 1935 and 1936 from various properties of the United States Smelting, Refining & Mining Co. at Tintic, including the Centennial-Beck, Eagle & Blue Bell, and Victoria groups; all the ore shipped was of smelting grade, and about 37,000 tons were produced each year. The Chief Consolidated Mining Co. continued operations at the Chief No. 1, Plutus, Eureka Hill, and Gemini properties in 1935 and 1936; the output in both years was chiefly lead ore and siliceous silver ore of smelting grade (a little lead-zinc ore was shipped from the Chief mine), and the output in 1936 was considerably less than that in 1935. Substantial increases in

output in 1936 over 1935 were reported at the Godiva, Empire Star, and Dragon mines.

In the eastern section of the Tintic district (Utah County) the Apex Standard, Eureka Lilly, Eureka Standard, May Day, North Lily, Tintic Bullion, Tintic Standard, Utah, Yankee, and Zuma mines were productive in 1936; all these properties were operated in 1935 except the Tintic Bullion. Large increases in output in 1936 compared with 1935 were reported at nearly all the foregoing mines and especially at the Eureka Standard and Tintic Standard properties. The Tintic Standard Mining Co. continued operations at the Tintic Standard mine in 1935 and 1936; the output of both siliceous ore and lead ore was considerably larger than in 1935. Considerably less ore was shipped from the Eureka Standard mine in 1936 than in 1935, but considerably more gold and silver were recovered. The Apex Standard mine was operated by the Chief Consolidated Mining Co., and the output increased from a few cars in 1935 to more than 6,300 tons in 1936. Production from the Eureka Lilly mine in 1936 was less than half that shipped in 1935.

MILLARD COUNTY

In 1936 gold ore of smelting grade was shipped from the E. P. H. and Charm mines in the Detroit district; in 1935 the Marette, Lone Eagle, Charm, Sunshine, and Deflation mines in the district were productive.

PIUTE COUNTY

The Annie Laurie mine in the Gold Mountain district was the most important producer in Piute County in both 1935 and 1936; siliceous gold ore was treated by amalgamation, cyanidation, and flotation, and the output of gold was considerably greater in 1936 than in 1935. The property was acquired during 1936 by the Allied Annie Laurie Gold Mines, Inc. The remainder of the county production in 1936 was siliceous ore of smelting grade from the General Connor, Deer Trail, Gold Strike, Wedge, and Arrastra properties.

SALT LAKE COUNTY

Big and Little Cottonwood districts.—The following table gives the combined output of mines in the Big and Little Cottonwood districts in 1935 and 1936.

Mine production of gold, silver, copper, lead, and zinc in Big Cottonwood and Little Cottonwood districts, Utah, 1935–36, and total, 1867–1936, in terms of recovered metals

Year	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1935	10	1,979	160.20	38,969	40,723	542,775	100,091	$63,111
1936	12	2,890	286.80	50,532	45,598	713,848	29,480	87,681
Total, 1867–1936		615,698	28,401.16	16,603,241	15,975,634	234,453,048	1,453,694	33,606,550

Most of the output from the Big Cottonwood district in 1935 and 1936 came from the property of the Cardiff Mining & Milling Co. In 1935 the company shipped lead ore and copper ore to smelters near Salt Lake City and lead-zinc ore to a smelter in the East; in 1936 the output was lead ore of smelting grade and lead-zinc ore sent to Midvale for milling. The remainder of the district output in 1936 was ore of smelting grade, chiefly from the Maxfield, Prince of Wales, Peruvian, Tar Baby, and Howell mines.

All the material shipped from mines in the Little Cottonwood district in 1936 was crude ore of smelting grade and came chiefly from the Alta Champion, Columbus, Columbus Rexall, and Dipper properties; these mines were also operated in 1935.

Bingham or West Mountain district.—The following tables give mine production of the West Mountain district in 1935 and 1936.

Mine production of gold, silver, copper, lead, and zinc in Bingham or West Mountain district, Salt Lake County, Utah, 1935–36, and total, 1865–1936, in terms of recovered metals

Year	Mines producing	Ore	Gold (lode and placer)	Silver (lode and placer)	Copper	Lead	Zinc	Total value
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1935	21	7,055,212	109,413.20	3,455,538	126,120,952	72,586,150	35,992,591	$21,268,289
1936	16	14,258,656	149,449.20	3,753,539	248,905,761	64,902,783	34,843,380	35,764,865
Total, 1865–1936		(1)	3,379,162.38	99,712.832	[2] 2,455,382	[2] 1,224,584	[2] 285,410	1,061,501,825

[1] Figures not available.
[2] Short tons.

Mine production of gold, silver, copper, lead, and zinc in Bingham or West Mountain district, Salt Lake County, Utah, 1935–36, by classes of ore, in terms of recovered metals

Class of ore	Mines producing	Ore	Gold (lode and placer)	Silver	Copper	Lead	Zinc
1935		*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	13	199,286	25,165.59	742,434	4,851,170	2,912,306	
Copper	7	6,530,162	67,646.90	596,761	119,005,003		
Lead	9	10,679	3,250.93	80,149	124,355	3,111,819	
Lead-zinc	4	315,085	13,346.18	2,036,194	2,140,424	66,562,025	35,992,591
Placers	2		3.60				
	[1] 19	7,055,212	109,413.20	3,455,538	126,120,952	72,586,150	35,992,591
1936							
Dry and siliceous	10	175,007	18,071.40	592,861	4,697,731	2,222,848	
Copper	3	13,774,115	117,275.60	1,056,776	241,986,065		
Lead	10	9,841	1,495.82	65,454	118,097	2,452,975	
Lead-zinc	6	299,693	12,606.38	2,038,448	2,103,868	60,226,960	34,843,380
	[1] 16	14,258,656	149,449.20	3,753,539	248,905,761	64,902,783	34,843,380

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

The Utah Copper Co. mined and milled 6,529,800 tons of ore in 1935 compared with 4,086,000 tons in 1934; the output in 1936 was 13,773,900 tons. The Arthur mill was reopened in September 1936, and during the last quarter of the year both the Arthur and Magna mills were operating at normal capacity. In addition to copper in

copper concentrates the company also recovered considerable copper in precipitates at the mine-water plant at Copperton. The company was by far the most important producer in Utah in both 1935 and 1936, and nearly all of the increase in copper production in the State came from the large open-cut mine at Bingham. The American Smelting & Refining Co. continued operations at the Boston Consolidated (Sulphide unit) of the Utah Copper Co. and in 1935 shipped nearly 48,000 tons of ore for smelting; in 1936 the output increased to nearly 71,000 tons.

The United States Smelting, Refining & Mining Co. continued regular operations at the United States & Lark and Niagara properties in 1935 and 1936. Considerably less ore was produced in 1936 than in 1935 due to the closing of the mines by a strike in October and November 1936. During 1936 the company secured the New England group of the Bingham Metals Co. by a long-term lease. The company also completed an addition to the flotation mill at Midvale, increasing the capacity to about 1,500 tons of lead-zinc ore a day.

Lessees continued operations at the Utah-Apex and Utah Delaware properties in 1935 and 1936 at a normal rate. Early in 1937 the two companies approved a consolidation agreement, and the National Tunnel & Mines Co. was formed to acquire the properties; the new company started driving a long tunnel from the Tooele side in 1937.

The output from the Park Bingham group of the Combined Metals Reduction Co. in 1935 was nearly doubled in 1936; most of the output was siliceous ore of smelting grade, but considerable lead-zinc ore is shipped to Bauer for milling.

The remainder of the district output in 1936 comprised copper precipitates shipped by the Ohio Copper Co., siliceous gold ore of smelting grade from the Utah Metal & Tunnel property, lead-zinc ore and silver ore from the Montana-Bingham group, and a little silver ore from the Opulent claim.

SUMMIT AND WASATCH COUNTIES

PARK CITY REGION

Mine production of gold, silver, copper, lead, and zinc in Park City region, Summit and Wasatch Counties, Utah, 1935–36, and total, 1870–1936, in terms of recovered metals

Year	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1935	14	206,954	8,006.20	2,500,256	697,579	26,360,250	19,318,886	$4,039,616
1936	12	238,313	5,973.00	2,708,949	558,543	34,842,457	27,157,160	5,319,133
Total, 1870–1936	-------	(1)	417,078.64	212,739,040	58,324,584	2,127,649,943	449,356,990	307,240,255

[1] Figures not available.

Mine production of gold, silver, copper, lead, and zinc in Park City region, Summit and Wasatch Counties, Utah, 1935–36, by classes of ore, in terms of recovered metals

Class of ore	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
1935		*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	5	11,036	851.97	139,730	23,201	206,483	
Lead	7	12,122	2,706.00	132,777	151,119	3,580,539	
Lead-zinc	8	183,796	4,448.23	2,227,749	523,259	22,573,228	19,318,886
	[1] 14	206,954	8,006.20	2,500,256	697,579	26,360,250	19,318,886
1936							
Dry and siliceous	5	24,238	768.17	325,955	17,161	314,800	
Lead	3	1,100	42.52	27,729	10,911	195,838	
Lead-zinc	8	212,975	5,162.31	2,355,265	530,471	34,331,819	27,157,160
	[1] 12	238,313	5,973.00	2,708,949	558,543	34,842,457	27,157,160

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

The Silver King Coalition Mines Co. continued operations at its property near Park City at about the same rate in 1935 and 1936. In 1935 the output was 101,725 tons of lead-zinc ore and 89 tons of lead ore; in 1936 it was 101,860 tons of lead-zinc ore and 353 tons of lead ore. Lead-zinc ore was treated in the company-owned flotation mill, and lead ore was shipped for smelting. The mine was closed for more than 2 months during the last quarter of 1936 due to a metal-mine strike in the district.

The Park City Development Co. continued shipments of lead-zinc ore and siliceous silver ore from the American Flag property in 1936, and production was also reported from the Daly, Flagstaff, Ontario, and City Unit (Park Utah Consolidated Mines Co.) properties.

Nearly all the output from the Wasatch County section of the Park City region in 1936 was lead-zinc ore of milling grade. The Park Utah Consolidated Mines Co. and the Park City Consolidated Mines Co. were the chief producers; most of the increase in output from the region in 1936 was due to greater output from the Judge mine of the former company. Production was also reported for 1936 from the New Park and New Quincy properties. The output of gold from the region decreased in 1936, largely as a result of the closing of the Liberty property of Park City Utah Mines Co. due to litigation.

TOOELE COUNTY

Camp Floyd (Mercur) district.—The Lewiston Peak Mining Co. and the Manning Gold Mining Co. continued regular operations at the Con Mercur mine and Manning dumps in 1935 and 1936; the companies were consolidated in 1936 into a new company called Snyder Mines, Inc. In 1935 the Manning cyanidation plant treated 185,293 tons of tailings from the old Manning dumps; in 1936 the remaining tailings (83,400 tons) in the dumps were treated. The mill also received considerable ore (nearly 17,000 tons in 1935 and more than 46,000 tons in 1936) from the Con Mercur property operated by the Lewiston Peak Mining Co. and the Snyder Mines, Inc. The output of gold from both the Con Mercur and Manning properties was considerably less in 1936 than in 1935.

The Geyser Marion Gold Mining Co. completed a new cyanidation plant at Mercur during 1935 and milled nearly 9,000 tons of ore; in 1936 the company treated nearly 25,000 tons of low-grade gold ore from the open-pit operations at the Geyser Marion mine.

Other producers in the district in 1936 included the Herschel, West Dip, and Overland (Sunshine) mines.

Ophir and Rush Valley districts.—The Hidden Treasure Mining & Development Co. shipped nearly 22,000 tons of lead-zinc ore to the mill at Midvale in 1936 compared with about 13,000 tons in 1935 and 4,000 tons in 1934; the company was by far the most important producer in the Ophir district in 1936. Nearly 3,600 tons of lead-zinc ore, silver ore, and lead ore were shipped from the Ophir Hill Consolidated property in 1936 compared with nearly 4,800 tons in 1935.

The Bluestone Lime & Quartzite Mining Co. shipped more than 28,000 tons of smelting-grade lead ore from the Cyclone & Tip Top property (Rush Valley district) in 1936 compared with about 24,000 tons in 1935. The Combined Metals Reduction Co. shipped nearly 32,000 tons of ore from the Honerine and West Calumet mines in 1936 compared with about 15,000 tons in 1935; most of the 1936 output was lead-zinc ore from the West Calumet mine treated in the Bauer mill and lead ore from the Honerine mine shipped to Tooele for smelting.

Other producers in 1936 included the Buffalo, Fisk, Kearsarge, Tintic Ophir, Queen of the Hills, Wandering Jew, Commodore, and Muirbrook properties.

UTAH COUNTY

American Fork district.—The following table gives the production from mines in the American Fork district in 1935 and 1936.

Mine production of gold, silver, copper, lead, and zinc in American Fork district, Utah, 1935–36, and total, 1870–1936, in terms of recovered metals

Year	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1935	8	3,059	776.40	17,273	58,337	179,900	296,841	$64,688
1936	7	1,680	400.40	18,652	32,272	183,500	143,480	47,044
Total, 1870–1936		145,692	43,641.08	2,212,109	2,285,068	32,874,443	775,828	5,322,600

Producing mines in the American Fork district in 1936 included the Blue Rock, Dutchman, Globe, Yankee, Miller, and Bog Iron properties.

Tintic district.—The mines in the Utah County section of the Tintic district are reviewed under Juab County.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN WASHINGTON

(MINE REPORT)

By C. N. Gerry and T. H. Miller

SUMMARY OUTLINE

The output of gold, silver, copper, lead, and zinc from Washington ores and gravels in 1936, in terms of recovered metals, was 12,217.40 fine ounces of gold, 66,900 fine ounces of silver, 204,000 pounds of copper, 1,680,000 pounds of lead, and 8,806,000 pounds of zinc. This output compares with a production in 1935 of 9,739.60 ounces of gold, 52,338 ounces of silver, 86,699 pounds of copper, 206,150 pounds of lead, and 2,159 pounds of zinc.

Since 1860 Washington has yielded an output of the five metals as follows: Gold, 1,514,508 fine ounces; silver, 9,506,380 fine ounces; copper, 27,373,495 pounds; lead, 71,971,177 pounds; and zinc, 49,517,110 pounds. The total value has amounted to $50,715,061.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the prices given in the table that follows. Gold in 1932 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1837, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95 per ounce, the yearly average weighted United States Government price[1]; and in 1935 and 1936 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1932 and 1933 is the average New York price for bar silver; in 1934, the Treasury buying price ($0.64646464+ per ounce) for newly mined silver; and in 1935 and 1936, the yearly average weighted Treasury buying price for newly mined silver. The copper, lead, and zinc prices are weighted yearly averages of all grades of primary metal sold by producers.

Prices of gold, silver, copper, lead, and zinc, 1932–36

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[1] $20.67+	$0.282	$0.063	$0.030	$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050

[1] $20.671835. [2] $0.64646464.

[1] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN WASHINGTON

(MINE REPORT)

By C. N. Gerry and T. H. Miller

SUMMARY OUTLINE

The output of gold, silver, copper, lead, and zinc from Washington ores and gravels in 1936, in terms of recovered metals, was 12,217.40 fine ounces of gold, 66,900 fine ounces of silver, 204,000 pounds of copper, 1,680,000 pounds of lead, and 8,806,000 pounds of zinc. This output compares with a production in 1935 of 9,739.60 ounces of gold, 52,338 ounces of silver, 86,699 pounds of copper, 206,150 pounds of lead, and 2,159 pounds of zinc.

Since 1860 Washington has yielded an output of the five metals as follows: Gold, 1,514,508 fine ounces; silver, 9,506,380 fine ounces; copper, 27,373,495 pounds; lead, 71,971,177 pounds; and zinc, 49,517,110 pounds. The total value has amounted to $50,715,061.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the prices given in the table that follows. Gold in 1932 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1837, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95 per ounce, the yearly average weighted United States Government price[1]; and in 1935 and 1936 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1932 and 1933 is the average New York price for bar silver; in 1934, the Treasury buying price ($0.64646464+ per ounce) for newly mined silver; and in 1935 and 1936, the yearly average weighted Treasury buying price for newly mined silver. The copper, lead, and zinc prices are weighted yearly averages of all grades of primary metal sold by producers.

Prices of gold, silver, copper, lead, and zinc, 1932–36

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[1] $20.67+	$0.282	$0.063	$0.030	$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050

[1] $20.671835. [2] $0.64646464.

[1] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Mine production of gold, silver, copper, lead, and zinc in Washington, 1932–36, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1932		55	42,272	5,082.13	$105,057	17,412	$4,910
1933		70	53,984	4,562.68	116,622	18,520	6,482
1934		210	47,902	8,301.83	290,149	44,120	28,522
1935		172	32,187	9,739.60	340,886	52,338	37,618
1936		106	133,435	12,217.40	427,609	66,900	51,814

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1932	5,524	$348	1,842,267	$55,268	4,489,334	$134,680	$300,263
1933	5,781	370	1,680,430	62,176	6,738,169	283,003	468,653
1934	13,900	1,112	581,298	21,508	3,852,419	165,654	506,945
1935	------	7,196	206,150	8,246	2,159	95	394,041
1936	204,000	18,768	1,680,000	77,280	8,806,000	440,300	1,015,771

Gold and silver produced at placer mines in Washington, 1932–36, in fine ounces, in terms of recovered metals

Year	Gold	Silver	Year	Gold	Silver
1932	386.95	75	1935	1,547.60	263
1933	990.96	166	1936	657.20	133
1934	1,773.45	317			

Gold.—The output of gold in Washington, in terms of recovered metal, was 12,217.40 fine ounces in 1936 compared with 9,739.60 ounces in 1935 and 8,301.83 ounces in 1934. Mines in Ferry County (chiefly in the Republic district) were the source of 57 percent of the total gold produced in Washington in 1936 and of 52 percent in 1935. The output of gold from Stevens County decreased decidedly in both 1935 and 1936 due to the closing of the First Thought mine at Orient, but that from Okanogan County increased sharply in both 1935 and 1936 due to the reopening of the Bodie mine near Wauconda. Gold ore yielded 94.33 percent and placers 5.38 percent of the total gold in 1936; crude ore of smelting grade yielded 51.09 percent of the total, concentrates of all classes 6.53 percent, and bullion from gold and silver mills 37.01 percent. There was a marked decrease in gold from small-scale placer mining in 1936.

Silver.—The output of silver was 66,900 fine ounces in 1936 compared with 52,338 ounces in 1935 and 44,120 ounces in 1934. Most of the silver produced in Washington comes from siliceous gold ore, and in 1936 the Mountain Lion and Aurum mines at Republic produced nearly half the total; silver ore, copper ore, and lead-zinc ore together yielded about 40 percent of the total. Crude ore of smelting grade yielded nearly 64 percent of the total silver in 1936 and concentrates of all classes about 29 percent.

Copper.—The output of copper in Washington was 204,000 pounds in 1936 compared with 86,690 pounds in 1935 and 13,900 pounds in 1934. The increases were due to the reopening in 1935 of the Royal mine near Leavenworth and the Sunset mine near Index, both pro-

ducers of copper ore. Nearly 79 percent of the copper produced in 1936 came from copper concentrates, and most of the remainder came from copper ore of smelting grade.

Lead and zinc.—The output of lead in Washington was 1,680,000 pounds in 1936 compared with 206,150 pounds in 1935 and 581,298 pounds in 1934. The output of zinc was 8,806,000 pounds in 1936 compared with 2,159 pounds in 1935 and 3,852,419 pounds in 1934. The marked decrease in the output of both lead and zinc in 1935 was due to the closing early in 1934 of the Josephine mine and mill of the Pend Oreille Mines & Metals Co., at Metaline Falls; the property was reopened in 1936 and yielded nearly all the lead and zinc produced. A little lead ore was marketed from the Electric Point and Gladstone Mountain mines near Northport in both 1935 and 1936, and a little lead-zinc ore was shipped from the Old Dominion mine near Colville in 1936; all three mines are in Stevens County.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Washington, 1935–36, by counties, in terms of recovered metals

County	Mines producing			Ore	Gold						Silver						Copper		Lead		Zinc		Total value
					Lode		Placer		Total		Lode		Placer		Total								
	Lode	Placer	Total	Short tons	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
1935																							
Asotin		12	12				49.40	$1,729	49.40	$1,729			4	$3	4	$3							$1,732
Benton		9	9				44.40	1,554	44.40	1,554			11	8	11	8							1,562
Chelan	4	21	25	704	21.40	$749	51.20	1,792	72.60	2,541	2,891	$2,078	3	2	2,894	2,080	38,169	$3,168					7,789
Clallam		4	4				43.80	1,533	43.80	1,533			7	5	7	5							1,538
Clark		1	1				5.20	182	5.20	182													182
Columbia		2	2				2.80	98	2.80	98													98
Douglas		5	5				39.00	1,365	39.00	1,365			7	5	7	5							1,370
Ferry	10	18	28	15,252	4,899.80	171,493	184.00	6,440	5,083.80	177,933	26,958	19,376	25	18	26,983	19,394	16,458	1,366	2,325	$93			198,786
Grant		2	2				11.60	406	11.60	406													406
Grays Harbor		3	3				5.20	182	5.20	182													182
Kittitas	3	16	19	68	92.20	3,227	184.40	6,454	276.60	9,681	39	28	39	28	78	56							9,737
Lincoln		3	3				49.60	1,736	49.60	1,736			7	5	7	5							1,741
Okanogan	16	21	37	9,151	1,412.00	49,420	213.80	7,483	1,625.80	56,903	3,463	2,489	43	31	3,506	2,520	879	73	4,200	168			59,664
Pend Oreille		3	3				6.00	210	6.00	210													210
Skagit		1	1				1.00	35	1.00	35													35
Skamania	1		1	1	16.00	560			16.00	560													560
Snohomish	2	15	17	99	17.80	623	64.40	2,254	82.20	2,877	594	427	7	5	601	432	27,663	2,296					5,605
Stevens	24	27	51	5,788	1,197.60	41,916	547.00	19,145	1,744.60	61,061	17,920	12,880	103	74	18,023	12,954	3,325	276	197,700	7,908	2,159	$95	82,294
Whatcom	3	1	4	1,124	535.20	18,732	2.20	77	537.40	18,809	210	151			210	151	205	17	1,925	77			19,054
Whitman		6	6				39.00	1,365	39.00	1,365			7	5	7	5							1,370
Yakima		2	2				3.60	126	3.60	126													126
	63	172	235	32,187	8,192.00	286,720	1,547.60	54,166	9,739.60	340,886	52,075	37,429	263	189	52,338	37,618	86,699	7,196	206,150	8,246	2,159	95	394,041
1936																							
Asotin		14	14				43.60	1,526	43.60	1,526			9	7	9	7							1,533
Benton		4	4				14.00	490	14.00	490			4	3	4	3							493
Chelan	1	11	12	10,510	12.40	434	21.20	742	33.60	1,176	7,694	5,959			7,694	5,959	92,413	8,502					15,637
Clallam		1	1				8.80	308	8.80	308													308
Douglas		4	4				16.80	588	16.80	588			5	4	5	4							592

Ferry	8	11	19	20,342	6,892.40	241,234	113.40	3,969	7,005.80	245,203	36,306	28,119	18	14	36,324	28,133	8,576	789					274,125
Grant		3	3				10.80	378	10.80	378			4	3	4	3							381
Grays Harbor		2	2				5.40	189	5.40	189													189
King	1		1	32	45.40	1,589			45.40	1,589	142	110			142	110			500	23			1,722
Kittitas	4	11	15	212	90.60	3,171	92.40	3,234	183.00	6,405	40	31	22	17	62	48							6,453
Lincoln		2	2				1.60	56	1.60	56													56
Okanogan	12	10	22	20,167	3,504.60	122,661	94.80	3,318	3,599.40	125,979	9,836	7,618	18	14	9,854	7,632	2,315	213	1,957	90			133,914
Pend Oreille	1	2	3	76,060			3.20	112	3.20	112	3,317	2,569			3,317	2,569	6,011	553	1,540,847	70,879	8,777,220	438,861	512,974
Skamania	1		1	5	4.00	140			4.00	140													140
Snohomish	1	14	15	1,483	12.60	441	31.20	1,092	43.80	1,533	1,246	965	9	7	1,255	972	92,935	8,550					11,055
Stevens	10	12	22	589	112.40	3,934	149.60	5,236	262.00	9,170	7,982	6,182	31	24	8,013	6,206	1,750	161	136,696	6,288	28,780	1,439	23,264
Whatcom	5		5	4,035	885.80	31,003			885.80	31,003	204	158			204	158							31,161
Whitman		4	4				28.80	1,008	28.80	1,008			4	3	4	3							1,011
Yakima		1	1				21.60	756	21.60	756			9	7	9	7							763
	44	106	150	133,435	11,560.20	404,607	657.20	23,002	12,217.40	427,609	66,767	51,711	133	103	66,900	51,814	204,000	18,768	1,680,000	77,280	8,806,000	440,300	1,015,771

MINING INDUSTRY

There were marked increases in the output of all five metals in Washington in 1936, and the total value of the output ($1,015,771) was larger than that for any year since 1925. Nearly 84 percent of the increase in total value over 1935 was in lead-zinc ore and resulted chiefly from the reopening of the property of Pend Oreille Mines & Metals Co. at Metaline Falls. The gains in gold and silver output resulted chiefly from the increased activity at mines near Republic, and the increase in copper output came from the Royal mine near Leavenworth and the Sunset mine near Index.

ORE CLASSIFICATION

Ore sold or treated in Washington, 1935–36, with content in terms of recovered metals

Source	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
1935		*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold ore	26	27,978	8,122.33	26,145	16,445	2,334	
Dry gold and silver ore	2	47	9.17	494		300	
Dry silver ore	13	3,120	19.74	17,135	3,332	20,478	
	41	31,145	8,151.24	43,774	19,777	23,112	
Copper ore	5	752	31.57	3,481	66,097		
Lead ore	16	287	8.90	4,744	825	181,738	
Lead-zinc ore	1	3	.29	76		1,300	2,159
	22	1,042	40.76	8,301	66,922	183,038	2,159
Total, lode mines	63	32,187	8,192.00	52,075	86,699	206,150	2,159
Total, placers	172		1,547.60	263			
	235	32,187	9,739.60	52,338	86,699	206,150	2,159
1936							
Dry gold ore	31	44,786	11,525.09	39,561	12,038	2,924	
Dry silver ore	5	381	10.11	8,503	603	2,586	
	36	45,167	11,535.20	48,064	12,641	5,510	
Copper ore	2	11,993	25.00	8,940	185,348		
Lead ore	4	106		690		121,230	
Lead-zinc ore	2	76,169		9,073	6,011	1,553,260	8,806,000
	8	88,268	25.00	18,703	191,359	1,674,490	8,806,000
Total, lode mines	44	133,435	11,560.20	66,767	204,000	1,680,000	8,806,000
Total, placers	106		657.20	133			
	150	133,435	12,217.40	66,900	204,000	1,680,000	8,806,000

Several new development projects begun or completed in 1936 were of especial interest to the mining industry in Washington. Of outstanding importance is the new 1,000-ton flotation plant at the Holden property, under construction early in 1937 by the Chelan Lake Division of the Britannia Mining & Smelting Co. Ltd., which when completed will be the largest milling plant in the State. The Knob Hill Mines, Inc., completed in April 1937 the construction of a new 400-ton all-slime cyanidation plant near Republic, Ferry County, and the American Smelting & Refining Co. completed and placed in operation in November 1936 a new cyanidation plant at the Azurite property in Whatcom County. Early in 1937 the Pend Oreille Mines & Metals Co. was building a 5,000-horsepower hydroelectric plant on the river below Metaline Falls; with the completion of the power

plant it is expected that the capacity of the Josephine mill will be increased from 300 to 600 tons daily. New activity was reported at many small lode-gold mines in Washington in 1936, but there was a marked decrease in work at small-scale placer properties.

Value of metals from ore sold or treated in Washington, 1935–36, by classes of ore

Class	Ore (short tons)	Gold	Silver	Copper	Lead	Zinc	Total value
1935							
Dry gold ore	27,978	$284,281	$18,791	$1,365	$93		$304,530
Dry gold and silver ore	47	321	355		12		688
Dry silver ore	3,120	691	12,316	277	819		14,103
Copper ore	752	1,105	2,502	5,486			9,093
Lead ore	287	312	3,410	68	7,270		11,060
Lead-zinc ore	3	10	55		52	$95	212
	32,187	286,720	37,429	7,196	8,246	95	339,686
1936							
Dry gold ore	44,786	403,378	30,640	1,108	134		435,260
Dry silver ore	381	354	6,586	55	119		7,114
Copper ore	11,993	875	6,924	17,052			24,851
Lead ore	106		534		5,577		6,111
Lead-zinc ore	76,169		7,027	553	71,450	440,300	519,330
	133,435	404,607	51,711	18,768	77,280	440,300	992,666

Gold ore.—The output of gold ore in Washington was 44,786 tons in 1936 compared with 27,978 tons in 1935 and 17,456 tons in 1934. Most of the increase in 1936 came from mines at Republic and from the Bodie mine near Wauconda. Of the total gold ore produced in 1936, nearly 43 percent (19,176 tons) was ore treated at amalgamation and concentration mills and nearly 41 percent (18,279 tons) was crude ore of smelting grade; in addition, 5,931 tons were cyanided, 500 tons were amalgamated, and 900 tons were concentrated. Mines in Ferry County produced 45 percent of the gold ore and those in Okanogan County 45 percent; most of the remainder came from Whatcom County.

Silver ore.—The decrease in output of silver ore in 1936 was due to the closing early in 1935 of the Deer Trail mine in the Springdale district, Stevens County; most of the output in 1936 came from the Silver Queen mine near Kettle Falls, Stevens County, and the Chloride Queen mine, Palmer Mountain district, Okanogan County.

Copper ore.—The output of copper ore was 11,993 tons in 1936 compared with 752 tons in 1935. All of the output in 1936 came from the Royal mine near Leavenworth and the Sunset mine near Index, and most of it was concentrated.

Lead ore.—All the lead ore produced in 1936 was of smelting grade; it came from four properties in Stevens County, including the Electric Point and Gladstone Mountain mines at Northport.

Lead-zinc ore.—The output of lead-zinc ore in Washington was 76,169 tons in 1936 compared with only 3 tons in 1935 and 28,322 tons in 1934. Most of the output in 1936 came from the Josephine mine of the Pend Oreille Mines & Metals Co. and was treated by flotation; the remainder came from the Old Dominion mine near Colville and was shipped to a custom mill near Kellogg, Idaho.

Ore sold or treated in Washington, 1935–36, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Chelan	53	15.20	7			
Ferry	15,126	4,883.77	24,022	16,036		
Kittitas	68	92.20	39			
Okanogan	9,053	1,396.51	1,004	193	250	
Skamania	1	16.00				
Stevens	2,553	1,183.45	863	11	159	
Whatcom	1,124	535.20	210	205	1,925	
	27,978	8,122.33	26,145	16,445	2,334	
1936						
Ferry	20,342	6,892.40	36,306	8,576		
King	32	45.40	142		500	
Kittitas	212	90.60	40			
Okanogan	19,990	3,495.56	2,649	2,212	719	
Skamania	5	4.00				
Stevens	170	111.33	220	1,250	1,705	
Whatcom	4,035	885.80	204			
	44,786	11,525.09	39,561	12,038	2,924	

DRY GOLD AND SILVER ORE[1]

County	Ore	Gold	Silver	Copper	Lead	Zinc
1935						
Ferry	35	7.63	387		300	
Okanogan	12	1.54	107			
	47	9.17	494		300	

DRY SILVER ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
1935						
Ferry	91	8.40	2,549	422	2,025	
Okanogan	72	5.74	1,996	277	375	
Stevens	2,957	5.60	12,590	2,633	18,078	
	3,120	19.74	17,135	3,332	20,478	
1936						
Okanogan	177	9.04	7,187	103	1,238	
Stevens	204	1.07	1,316	500	1,348	
	381	10.11	8,503	603	2,586	

COPPER ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
1935						
Chelan	651	6.20	2,884	38,169		
Okanogan	2	7.57	3	265		
Snohomish	99	17.80	594	27,663		
	752	31.57	3,481	66,097		
1936						
Chelan	10,510	12.40	7,694	92,413		
Snohomish	1,483	12.60	1,246	92,935		
	11,993	25.00	8,940	185,348		

LEAD ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
1935						
Okanogan	12	0.64	353	144	3,575	
Stevens	275	8.26	4,391	681	178,163	
	287	8.90	4,744	825	181,738	
1936						
Stevens	106		690		121,230	
	106		690		121,230	

[1] None produced in 1936.

Ore sold or treated in Washington, 1935–36, by counties, with content in terms of recovered metals—Continued

LEAD-ZINC ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Stevens	3	0.29	76		1,300	2,159
	3	.29	76		1,300	2,159
1936						
Pend Oreille	76,060		3,317	6,011	1,540,847	8,777,220
Stevens	109		5,756		12,413	28,780
	76,169		9,073	6,011	1,553,260	8,806,000

METALLURGIC INDUSTRY

The total output of ore in Washington in 1936 was 133,435 tons, comprising 89,164 tons treated at concentration plants, 25,607 tons treated at gold and silver mills, and 18,664 tons shipped crude to smelters.

The ore treated at gold and silver mills comprised 500 tons treated at nine small straight-amalgamation mills, 5,931 tons treated at three straight-cyanidation mills, and 19,176 tons treated at three combined amalgamation and gravity-concentration plants.

Five straight-concentration plants were operated in Washington in 1936 and treated 89,164 tons of ore—two plants treating siliceous ore, two treating copper ore, and one treating lead-zinc ore. Most of the ore concentrated was lead-zinc ore (76,169 tons) and copper ore (11,910 tons) treated by flotation. The following tables give production of concentrates by classes and counties.

Gross metal content of Washington concentrates produced, 1935–36, by classes of concentrates

Class of concentrates	Concentrates produced (dry weight)	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	242	98.94	9,974	2,542	22,238	
Copper	77	6.20	2,861	39,668		
Lead	6	1.09	609	164	1,891	
	325	106.23	13,444	42,374	24,129	
1936						
Dry and siliceous	262	778.13	927	2,861	121	
Copper	310	19.01	8,367	166,243		
Lead	1,159	.14	8,263	2,358	1,591,520	57,838
Zinc	8,161		1,867	6,100	32,505	9,783,581
	9,892	797.28	19,424	177,562	1,624,146	9,841,419

Mine production of metals from Washington concentrates, 1935–36, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Chelan	77	6.20	2,861	38,080		
Okanogan	38	93.73	113			
Stevens	210	6.30	10,470	2,521	18,174	
	325	106.23	13,444	40,601	18,174	
1936						
Chelan	188	12.40	7,694	92,413		
Okanogan	241	702.15	917	2,152	116	
Pend Oreille	9,276		3,317	6,011	1,540,847	8,777,220
Snohomish	122	6.61	673	68,214		
Stevens	44	.14	6,813	364	13,526	28,780
Whatcom	21	75.98	10			
	9,892	797.28	19,424	169,154	1,554,489	8,806,000

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
1935						
Dry and siliceous	242	98.94	9,974	2,398	16,359	
Copper	77	6.20	2,861	38,080		
Lead	6	1.09	609	123	1,815	
	325	106.23	13,444	40,601	18,174	
1936						
Dry and siliceous	262	778.13	927	2,152	116	
Copper	310	19.01	8,367	160,627		
Lead	1,159	.14	8,263	1,789	1,527,852	
Zinc	8,161		1,867	4,586	26,521	8,806,000
	9,892	797.28	19,424	169,154	1,554,489	8,806,000

The output of crude ore of smelting grade in Washington was 18,664 tons in 1936 compared with 15,296 tons in 1935 and 16,185 tons in 1934. Nearly all the ore smelted in 1936 was gold ore shipped from the Republic district to Tacoma for smelting. Small lots also of silver ore, lead ore, and copper ore were shipped to smelters.

Gross metal content of Washington crude ore shipped to smelters, 1935–36, by classes of ore

Class of ore	Quantity (dry weight)	Gross metal content			
		Gold	Silver	Copper	Lead
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry and siliceous	14,941	5,885.20	32,055	18,170	8,820
Copper	102	25.37	620	29,268	
Lead	253	7.81	4,135	878	188,158
	15,296	5,918.38	36,810	48,316	196,978
1936					
Dry and siliceous	18,475	6,235.85	41,508	10,955	5,500
Copper	83	5.99	573	25,751	
Lead	106		690		126,272
	18,664	6,241.84	42,771	36,706	131,772

Mine production of metals from Washington crude ore shipped to smelters, 1935–36, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
1935	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Chelan	1		23	89	
Ferry	12, 152	4, 578. 43	26, 062	16, 458	2, 325
Okanogan	145	52. 74	2, 575	879	4, 200
Snohomish	99	17. 80	594	27, 663	
Stevens	2, 847	1, 188. 07	7, 373	804	178, 226
Whatcom	52	81. 34	183	205	1, 925
	15, 296	5, 918. 38	36, 810	46, 098	186, 676
1936					
Ferry	17, 986	5, 978. 93	33, 410	8, 576	
King	32	45. 40	142		500
Okanogan	261	78. 28	7, 328	163	1, 841
Snohomish	83	5. 99	573	24, 721	
Stevens	295	112. 26	1, 169	1, 386	123, 170
Whatcom	7	20. 98	149		
	18, 664	6, 241. 84	42, 771	34, 846	125, 511

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead
1935					
Dry and siliceous	14, 941	5, 885. 20	32, 055	17, 379	6, 753
Copper	102	25. 37	620	28, 017	
Lead	253	7. 81	4, 135	702	179, 923
	15, 296	5, 918. 38	36, 810	46, 098	186, 676
1936					
Dry and siliceous	18, 475	6, 235. 85	41, 508	10, 125	4, 281
Copper	83	5. 99	573	24, 721	
Lead	106		690		121, 230
	18, 664	6, 241. 84	42, 771	34, 846	125, 511

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Washington, 1935–36, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
1935			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Asotin County: Snake River		12			49.40	49.40		4	4				$1,732
Benton County: Columbia River		9			44.40	44.40		11	11				1,562
Chelan County:													
Blewett	1	7	45	9.20	20.80	30.00	4	3	7				1,055
Columbia River		5			8.20	8.20							287
Entiat	1		8	6.00		6.00	3		3				212
Leavenworth	2		651	6.20		6.20	2,884		2,884	38,169			5,458
Wenatchee River		9			22.20	22.20							777
Clallam County: Ozette		4			43.80	43.80		7	7				1,538
Clark County: Pine Creek		1			5.20	5.20							182
Columbia County: Snake River		2			2.80	2.80							98
Douglas County: Columbia River		5			39.00	39.00		7	7				1,370
Ferry County:													
Columbia River		15			178.40	178.40		25	25				6,262
Danville	1		679	445.20		445.20	352		352	16,036			17,166
Enterprise	1		79	8.20		8.20	2,222		2,222	48	1,700		1,956
Keller	2		12	.20		.20	327		327	374	325		286
Republic	6	3	14,482	4,446.20	5.60	4,451.80	24,057		24,057		300		173,116
Grant County: Columbia River		2			11.60	11.60							406
Grays Harbor County: Pacific Beach		3			5.20	5.20							182
Kittitas County: Swauk	3	16	68	92.20	184.40	276.60	39	39	78				9,737
Lincoln County: Columbia River		3			49.60	49.60		7	7				1,741
Okanogan County:													
Cascade	2		9,007	1,348.00		1,348.00	1,170		1,170	132	2,200		48,120
Columbia River		7			36.20	36.20		7	7				1,272
Myers Creek and Mary Ann Creek	1	6	5	1.40	163.20	164.60		36	36				5,787
Nespelem	3		23	3.60		3.60	839		839	12	1,375		785
Omak		1			.20	.20							7
Palmer Mountain	8		82	26.00		26.00	1,344		1,344	470	375		1,930
Similkameen River		4			10.80	10.80							378
Upper Methow	2	3	34	33.00	3.40	36.40	110		110	265	250		1,385
Pend Oreille County: Metaline		3			6.00	6.00							210
Skagit County: Skagit River		1			1.00	1.00							35
Skamania County: Niggerhead	1		1	16.00		16.00							560
Snohomish County:													
Index	1		67	12.20		12.20	512		512	24,868			2,859

Skykomish River		6			10.00	10.00							350
Stillaguamish	1		32	5.60		5.60	82		82	2, 795			487
Sultan		9			54.40	54.40		7	7				1, 909
Stevens County:													
Bossburg	4		23	.40		.40	135		135	84	6, 450		376
Chewelah	2		4	.20		.20	85		85	48	2, 575		175
Columbia River		20			439.00	439.00		82	82				15, 424
Colville	5		84	8.00		8.00	3, 833		3, 833	374	9, 900	2, 159	3, 557
Kettle Falls	2		5	3.00		3.00	50		50				141
Northport	5	7	160		108.00	108.00	530	21	551	145	160, 150		10, 594
Orient	4		2, 556	1, 180.40		1, 180.40	903		903	60	575		41, 991
Springdale	1		2, 256	1.40		1.40	6, 962		6, 962	349	4, 600		5, 266
Summit	1		700	4.20		4.20	5, 422		5, 422	2, 265	13, 450		4, 770
Whatcom County:													
Mount Baker	1		1, 067	451.80		451.80	25		25				15, 831
Ruby Creek		1			2.20	2.20							77
Slate Creek	2		57	83.40		83.40	185		185	205	1, 925		3, 146
Whitman County: Snake River		6			39.00	39.00		7	7				1, 370
Yakima County: Yakima River		2			3.60	3.60							126
Total Washington	63	172	32, 187	8, 192.00	1, 547.60	9, 739.60	52, 075	263	52, 338	86, 699	206, 150	2, 159	394, 041
1936													
Asotin County: Snake River		14			43.60	43.60		9	9				1, 533
Benton County: Columbia River		4			14.00	14.00		4	4				493
Chelan County:													
Columbia River		2			5.60	5.60							196
Leavenworth	1		10, 510	12.40		12.40	7, 694		7, 694	92, 413			14, 895
Peshastin Creek		2			9.00	9.00							315
Wenatchee River		7			6.60	6.60							231
Clallam County: Ozette		1			8.80	8.80							308
Douglas County: Columbia River		4			16.80	16.80		5	5				592
Ferry County:													
Columbia River		10			110.00	110.00		18	18				3, 864
Danville	2		308	142.60		142.60	217		217	8, 576			5, 948
Republic	6	1	20, 034	6, 749.80	3.40	6, 753.20	36, 089		36, 089				264, 313
Grant County: Columbia River		3			10.80	10.80		4	4				381
Grays Harbor County: Pacific Beach		2			5.40	5.40							189
King County: Miller River	1		32	45.40		45.40	142		142		500		1, 722
Kittitas County: Swauk	4	11	212	90.60	92.40	183.00	40	22	62				6, 453
Lincoln County: Columbia River		2			1.60	1.60							56
Okanogan County:													
Cascade	2		18, 959	2, 932.20		2, 932.20	1, 929		1, 929		152		104, 128
Columbia River		4			28.60	28.60		5	5				1, 005
Conconully	1		18	.60		.60	550		550	76	174		462
Methow	3	2	940	487.40	1.40	488.80	634		634	2, 152	283		17, 810
Myers Creek and Mary Ann Creek	2	2	75	58.60	53.60	112.20	40	9	49				3, 965
Palmer Mountain	4		175	25.80		25.80	6, 683		6, 683	87	1, 348		6, 149
Similkameen River		2			11.20	11.20		4	4				395
Pend Oreille County: Metaline	1	2	76, 060		3.20	3.20	3, 317		3, 317	6, 011	1, 540, 847	8, 777, 220	512, 974
Skamania County: Niggerhead	1		5	4.00		4.00							140

Mine production of gold, silver, copper, lead, and zinc in Washington, 1935–36, by counties and districts, in terms of recovered metals—Contd.

County and district	Mines producing		Ore	Gold			Silver			Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
1936—Continued			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Snohomish County:													
Index	1		1,483	12.60		12.60	1,246		1,246	92,935			$9,956
Sultan		14			31.20	31.20		9	9				1,099
Stevens County:													
Big Sheep Creek		1			1.80	1.80							63
Bossburg	1		5				541		541		5,500		672
Columbia River		11			147.80	147.80		31	31				5,197
Colville	1		109				5,756		5,756		12,413	28,780	6,468
Kettle Falls	3		207	5.00		5.00	1,326		1,326	500	1,348		1,310
Northport	3		148	22.80		22.80	297		297	1,250	114,348		6,403
Orient	2		120	84.60		84.60	62		62		3,087		3,151
Whatcom County:													
Mount Baker	2		400	347.20		347.20	31		31				12,176
Slate Creek	3		3,635	538.60		538.60	173		173				18,985
Whitman County: Snake River		4			28.80	28.80		4	4				1,011
Yakima County: Morris Creek		1			21.60	21.60		9	9				763
Total Washington	44	106	133,435	11,560.20	657.20	12,217.40	66,767	133	66,900	204,000	1,680,000	8,806,000	1,015,771

CHELAN COUNTY

The Royal Development Co. resumed production at the Royal mine north of Leavenworth in 1935 and operated continuously during 1936. More than 10,000 tons of low-grade copper ore were treated in the 350-ton flotation plant during 1936. Copper concentrates are stored during the winter months; they are shipped to Tacoma for smelting.

The Chelan Lake Division of the Britannia Mining & Smelting Co., Ltd., resumed development in May 1936 at the Holden mine about 50 miles northwest of Chelan; the mine is reached by boat from Chelan to Lucerne and by road from Lucerne. Extensive diamond drilling has been completed at the mine, and during 1936 a large crew was driving the lower adit. Early in 1937 the company let contracts for the construction of a flotation plant, a 50-mile power line, docks, barges, and other equipment necessary for operation on a 1,000-ton-daily basis. About 1 year will be required to complete the present construction program.

FERRY COUNTY

Republic district.—Siliceous gold ore from mines near Republic in 1935 and 1936 represented, as usual, a substantial part of the State's total metal production. The output of the Republic district was valued at $173,116 in 1935 and at $264,194 in 1936. The chief producers in 1935 were the Aurum and Blaine Republic mines and in 1936 the Mountain Lion, Aurum, Quilp, and Morning Glory mines. The Blaine Republic mine and cyanide mill were closed early in 1936. The Eureka M. & M. Co. was formed during 1936 to operate the Quilp property; the company also has a 10-year lease on the Blaine Republic property, and in November and December 1936 ore from the Quilp mine was being treated in the 60-ton cyanidation mill on the Republic property. Ore from the Mountain Lion, Aurum, and Morning Glory mines was shipped for smelting. No production during 1936 was reported from the Knob Hill mine.

Diamond drilling was completed on the Mud Flat claim (part of the Knob Hill group), and the Knob Hill Mines, Inc., was formed in 1936 to acquire the property and erect a new 400-ton cyanidation plant. Construction was delayed by severe winter weather, but in April 1937 the new all-slime plant was completed.

Other districts.—Other production from Ferry County in 1935 and 1936 included gold ore from the Morning Star mine near Danville and placer bullion from various bars on the Columbia River.

KITTITAS COUNTY

Small lots of rich gold ore from several mines (including the Mountain Daisy, Liberty, and Morris) near Liberty were treated by amalgamation in both 1935 and 1936; most of the placer output came from the Burcham and Sunny Bar properties. A new sluicing plant was built in 1936 at the Boulder placer of the Salem Mining Co., but operations were discontinued and the plant was dismantled after a short run.

OKANOGAN COUNTY

The Northern Gold Corporation was formed in 1935 to operate the Bodie mine 12 miles north of Wauconda. The company rebuilt the milling plant (70-ton amalgamation and gravity-concentration) and in 1935 treated about 9,000 tons of ore, shipping bullion and rich gold concentrates. The production was doubled in 1936 when nearly 19,000 tons of ore were milled. Other producing lode mines in Okanogan County in 1936 included the Golconda mine near Wauconda, the Red Shirt mine near Twisp, the Gray Eagle and Peterson properties near Chesaw, the Chloride Queen mine near Nighthawk, and the Spokane and Owasco properties near Oroville. Placers were operated in 1936 along the Columbia, Similkameen, and Twisp Rivers and on Myers and Mary Ann Creeks.

PEND OREILLE COUNTY

Metaline district.—The Pend Oreille Mines & Metals Co. suspended production at the Josephine property in April 1934, and no ore was mined or milled until operations were resumed in 1936, when the company milled 76,060 tons of lead-zinc ore in the new 300-ton flotation plant. Underground development at the Josephine mine was carried on continuously during the shut-down. The company also dismantled the old mill at the Josephine shaft and erected a new plant (salvaging some of the equipment from the old mill) at a site on the Cascade tunnel level. Early in 1937 the company was building a 5,000-horsepower hydroelectric plant on the river below Metaline Falls, and upon completion of the plant the milling capacity probably will be increased to about 600 tons a day.

The Metaline Mining & Leasing Co., controlled by the American Zinc, Lead & Smelting Co., made no production in 1936, but a large tunnel crew was employed from May 1 until the end of the year in driving nearly 2,300 feet at the main haulage tunnel.

SNOHOMISH COUNTY

The Sunset mine at Index was operated from September 1936 to the end of the year by the Sunset Syndicate Corporation. Copper ore was treated in the 150-ton concentrator, and concentrates and some crude ore were shipped to Tacoma for smelting. Placer bullion was marketed from small-scale operations on the Sultan River.

STEVENS COUNTY

The First Thought mine near Orient, an important producer of gold in 1935, was closed early in 1936; a 50-ton cyanidation mill was being built at the property in 1936. Other producing lode mines in Stevens County in 1936 included the Electric Point and Gladstone Mountain properties near Northport and the Old Dominion property near Colville. Placer operations along the Columbia River yielded considerable gold in both 1935 and 1936.

WHATCOM COUNTY

The American Smelting & Refining Co. continued development work at the Azurite property in the Slate Creek district during 1935 and in November 1936 completed and placed in operation a 100-ton cyanidation plant; several thousand tons of ore were treated in the new mill before the end of the year. The Boundary Red Mountain mine in the Mount Baker district was formerly a large producer of gold in Washington; it was purchased in 1935 by the International Gold Mines, Ltd. Several hundred tons of ore were treated in 1935; in 1936 the operating season was disrupted by failure of the power plant, and only 200 tons of material were treated. Repairs were made, however, and the mill (amalgamation and concentration) was rebuilt; operations were resumed in 1937. Gold ore was also produced at the Whistler, New Light, and Tom, Dick, & Harry properties.

GOLD, SILVER, COPPER, AND LEAD IN WYOMING

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

Lode and placer mines in Wyoming produced, in terms of recovered metals, 1,964.40 fine ounces of gold and 1,113 fine ounces of silver in 1936 compared with 3,715.00 ounces of gold, 1,152 ounces of silver, 1,000 pounds of copper, and 5,000 pounds of lead in 1935. The Atlantic City district, Fremont County, yielded nearly all the gold in 1936; the remainder (40.89 ounces) was contained in ore, amalgamation bullion, and placer dust shipped from scattered districts in Albany, Carbon, and Park Counties. The silver was a byproduct of gold mining, except the 839 ounces produced in the Kirwin district, Park County. There were 5 producing lode mines and 25 placers in 1936 compared with 10 and 38, respectively, in 1935.

The total recorded production of gold, silver, copper, and lead (in terms of recovered metals) in Wyoming from 1867 to 1936, inclusive, according to Chas. W. Henderson, has been 73,515 fine ounces of gold, 73,766 fine ounces of silver, 32,638,059 pounds of copper, and 16,800 pounds of lead.

Calculation of value of metal production.—The value of metal production herein reported has been calculated at the prices given in the table that follows. Gold in 1932 is figured at $20.671835 per ounce, the Treasury legal coinage value for fine gold from January 18, 1837, to January 31, 1934; in 1933 at $25.56 and in 1934 at $34.95 per ounce, the yearly average weighted United States Government price[1]; and in 1935 and 1936 at $35 per ounce, under authority of the Gold Reserve Act of January 31, 1934. The silver price in 1932 and 1933 is the average New York price for bar silver; in 1934, the Treasury buying price ($0.64646464+ per ounce) for newly mined silver; and in 1935 and 1936, the yearly average weighted Treasury buying price for newly mined silver. The copper, lead, and zinc prices are weighted yearly averages of all grades of primary metal sold by producers.

[1] The Treasury from Feb. 1, 1934, through December 1934 has calculated all gold, old and new, at $35 per ounce, under authority of the Gold Reserve Act of Jan. 31, 1934. Details of the U. S. Government fluctuating price of gold in 1933 to Jan. 31, 1934, may be found in Minerals Yearbook, 1934, pp. 25–28.

Prices of gold, silver, copper, lead, and zinc, 1932–36

Year	Gold	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1932	[1] $20.67+	$0.282	$0.063	$0.030	$0.030
1933	25.56	.350	.064	.037	.042
1934	34.95	[2] .646+	.080	.037	.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050

[1] $20.671835. [2] $0.64646464.

Mine production of gold, silver, copper, and lead in Wyoming, 1932–36, in terms of recovered metals

Year	Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)		Copper		Lead		Total value
		Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	
1932	640	256.63	$5,305	195	$55	397	$25	9,800	$294	$5,679
1933	1,071	2,199.95	56,231	260	91					56,322
1934	8,173	4,871.36	170,254	710	459	3,500	280	2,000	74	171,067
1935	4,190	3,715.00	130,025	1,152	828	1,000	83	5,000	200	131,136
1936	344	1,964.40	68,754	1,113	862					69,616

Mine production of gold and silver in Wyoming in 1936, by counties, in terms of recovered metals

County	Mines producing		Ore sold or treated	Gold			Silver			Total value of gold and silver
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total	
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	
Albany and Carbon	2	1	92	34.80	4.69	39.49	4		4	$1,385
Fremont	2	24	239	278.40	1,645.11	1,923.51	44	226	270	67,532
Park	1		13	1.40		1.40	839		839	699
	5	25	344	314.60	1,649.80	1,964.40	887	226	1,113	69,616
Total, 1935	10	38	4,190	1,009.80	2,705.20	3,715.00	800	352	1,152	130,853

REVIEW BY COUNTIES AND DISTRICTS

ALBANY COUNTY

The only output from Albany County in 1936 was 17 tons of dry gold ore shipped by the Star Mining Co. to the Garfield (Utah) smelter from a property in the Douglas Creek district. The Rare Metals Corporation drove 90 feet of development at its Electrolytic group, in the same district, from September 1 to December 31. Other properties at which development work was reported during the year were the New Deal group in the Albany district and the Cliff group and Commercial Gold Mining Co. property in the Centennial district.

CARBON COUNTY

A 7-ton stamp mill with amalgamation plates was run for a few months during the latter half of 1936 on ore from the Nellie F claim in the Gold Hill district, in secs. 15 and 16, T. 16 N., R. 80 W., sixth principal meridian; amalgamation bullion recovered was shipped to the Denver

Mint. The Golden Sun Mining Syndicate, Inc., did considerable development work from January 1 to August 1 at the Vulcan group near Encampment. Extensive testing was done during the summer months at the J. Phillips placer property in the Spring Creek area. Sluicing at the Working Boy placer on Savery Creek yielded several ounces of placer gold.

FREMONT COUNTY

Atlantic City district.—Two companies using dragline excavators and portable screening and sluicing equipment on placer ground in the Atlantic City district recovered 78 percent of the total output of gold in Wyoming in 1936. One of these, the largest producer, was the E. T. Fisher Co.,[2] operating on Rock Creek for its fourth season; it worked 200 days in 1936, as in 1935. The Fisher apparatus consists of a 1½-cubic yard dragline bucket and a screening-sluicing-amalgamation plant mounted on rail tracks and pulled ahead by the power of the dragline. The second largest producer was the Jett-Ross Mines, Inc., which operated on Big Atlantic Gulch from April 24 to September 15 with equipment similar to that of the E. T. Fisher Co. The Rigdon Mines Co. moved a dragline excavator and screening and sluicing equipment to the May Day-Megget placer in July but operated for a short period only. Small-scale sluicing operations by individuals yielded 81 ounces of gold.

The Iron Duke-Hidden Hand lode mine was operated during the first part of 1936 by the Iron Duke Mining Co. and later in the year by various lessees; the ore produced was sold to the Midvale (Utah) smelter. The Duncan mine was idle throughout the year; the only output was amalgamation bullion and concentrates recovered from clean-up operations at the mill. The Gold Dollar and Miners Delight groups were consolidated and operations under the new firm name of Miners Delight Consolidated Mines Co. were planned for 1937.

PARK COUNTY

Lessees at the Little Johnnie mine in the Kirwin district, about 70 miles southwest of Cody, shipped 13 tons of silver ore to the East Helena (Mont.) smelter in 1936.

[2] Ross, Charles L., and Gardner, E. D., Placer-Mining Methods of E. T. Fisher Co., Atlantic City, Wyo.: Inf. Circ. 6846, Bureau of Mines, 1935, 11 pp.

SECONDARY METALS

By J. P. Dunlop [1]

SUMMARY OUTLINE

The total value of certain nonferrous metals, for which the quantity recovered from secondary sources is reported to the Bureau of Mines, was $174,183,300 in 1936, $19,146,500 more than in 1935; the total quantity increased 58,785 short tons. The increase in total value was due partly to higher average prices for copper, zinc, and lead, but the recovery of secondary copper, zinc, tin, aluminum, antimony, and nickel also increased.

Secondary metals of certain classes recovered in the United States, 1935–36

	1935		1936	
	Short tons	Value	Short tons	Value
Copper, including that in alloys other than brass	364,300	$60,473,800	365,300	$67,215,200
Brass scrap re-treated	120,800	16,683,600	170,400	26,211,200
Lead as metal	156,800	21,632,000	137,500	24,186,800
Lead in alloys	113,600		125,400	
Zinc as metal	55,400	5,662,800	68,000	7,950,000
Zinc in alloys other than brass	8,950		11,500	
Tin as metal	9,600	27,498,200	7,250	25,621,500
Tin in alloys and chemical compounds	18,300		20,770	
Aluminum as metal	23,500	19,018,000	20,900	19,055,000
Aluminum in alloys	27,900		30,600	
Antimony as metal and in alloys	9,600	2,703,400	9,900	2,568,100
Nickel as metal	700	1,365,000	855	1,375,500
Nickel in nonferrous alloys and salts	1,250		1,110	
	910,700	155,036,800	969,485	174,183,300

Scope of report.—"Secondary metals" are those recovered from scrap metal, sweepings, skimmings, and drosses and are so called to distinguish them from metals derived directly from ores, which are termed "primary metals." The distinction does not imply that secondary metals are of inferior quality, for metals derived either from ore or from waste material vary in purity and in adaptability to use in making certain products. The figures furnished by producers cover seven metals—secondary copper, lead, zinc, tin, aluminum,

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

antimony, and nickel—and supplement those on the primary metals. They are given to enable producers and consumers to form a more comprehensive idea of the quantities of metal available for consumption; in fact, they constitute an essential complement to the figures in the general reports on the primary metals and will become more valuable in the future.

The variety of waste material (especially metallic wastes), its utilization, and much information on its collection and disposal appear in reports of this series for preceding years. These reports name the various trade papers that cover the subject of secondary metals and refer to many articles relating to secondary metals recovered.

Several papers [2] presented at the 1937 annual meeting of the National Association of Waste Material Dealers, Inc., dealt with the problems and needs of metal dealers and brokers in the scrap-metal industry.

SECONDARY METALS RECOVERED

The quantity of metals contained in numerous alloys made partly or wholly from secondary material cannot be ascertained definitely. The figures in the following tables and text, which are based upon results of the annual canvass, are approximate but constitute the only available data on an industry of growing importance.

Mints and refineries reported the recovery of 1,025,022 fine ounces of gold and 16,703,353 fine ounces of silver from waste or discarded material in 1936, compared with 1,668,305 ounces of gold and 35,903,107 ounces of silver in 1935. Jewelry and dental waste furnish the largest quantity of secondary gold and silverware and photographic waste the largest quantity of secondary silver.

No data are collected by the Bureau of Mines showing the quantity and value of old rails, pipe, machinery, and other equipment renovated for original use. Newspapers and trade publications show that an enormous quantity of such ferrous material is salvaged and reused.

In 1936 the price of heavy copper scrap ranged from 7.125 cents a pound to 9.375 cents, No. 1 composition scrap from 5.50 to 8.125 cents a pound, old zinc scrap from 2.56 to 2.92 cents a pound, cast aluminum scrap from 11.50 to 12.87 cents a pound, and heavy lead scrap from 3.69 to 4.89 cents a pound. The average daily and weekly quotations for many scrap metals and alloys can be found in the Waste Trade Journal, Waste Trade Review, Metal Industry, and American Metal Market. The price of old tin pipe ranged from 36.83 to 44.05 cents a pound and averaged 38.95 cents, but the quantity of tin pipe marketed is quite small.

The favorable feature of the spread in secondary-metal prices in 1936 was the fact that, except in a very few instances, prices were lowest at the beginning of the year and increasingly higher during the last part of the year, when the rapid advance in metal prices carried scrap and secondary-metal prices to proportionately higher levels.

[2] Wilson, Lester T., Scientific Methods Needed in Dealing in Scrap Metals: Waste Trade Jour., Mar. 27, 1937, pp. 57, 59, 231.
Schumann, S. E., Metal Specialties Need Closer Study: Waste Trade Jour., Mar. 27, 1937, pp. 111, 113, 118.
Levitt, Henry, Scrap-Metal Industry Indispensable as a Source of Raw Material: Waste Trade Jour., Mar. 27, 1937, pp. 71, 73, 75.
Bourrienne, A. J., Our Foreign Trade in Waste Materials Shows Great Gain: Waste Trade Jour., Mar. 27, 1937, pp. 159, 161.
Lipkowitz, Abe, Direct Dealing Does Not Pay in the Scrap-Metal Industry: Waste Trade Jour., Mar. 27, 1937, pp. 137, 141.

Demand for secondary metals depends largely on general industrial conditions; hence the business improvement in 1936 reacted favorably on the secondary-metals trade. Foundries long inactive or operated at small capacity for several years absorbed large quantities of scrap or ingot made from waste metals, and the automotive industry purchased large quantities of secondary aluminum.

The quantity of scrap copper re-treated did not increase, and regular smelters treated less scrap copper in 1936 than in 1935. On the other hand, the quantity of brass scrap remelted increased about 50,000 tons. The decrease in production of secondary lead as metal was much greater than the increase in lead recovered in alloys. Probably some scrap copper and scrap lead were being held by dealers who expected increases in prices, and large sales that would increase profits in the last 2 months of 1936 probably were not desired. The increase in the price of copper will permit shipment of considerable low-grade foundry ashes and skimmings which it has been impossible to market at any price for several years.

A number of medium-size secondary smelters did not sell to ultimate consumers in 1936 but shipped their output to large secondary-metal interests having steady large outlets for materials. On the whole, 1936 was a moderately successful year for most dealers and smelters of secondary metals, and prospects are that 1937 will be a most prosperous year.

There were few important failures in the trade and few new small enterprises. The general tendency is toward greater concentration of the secondary-metal business in the hands of the large operators and interests that deal largely in primary metals.

During the past 2 years the Bureau of Mines has made surveys of consumption of scrap iron and scrap steel.[3] Consumption of home scrap totaled 18,860,000 gross tons in 1936 compared with 13,347,000 tons in 1935 and that of purchased scrap, 17,609,000 tons in 1936 compared with 13,069,000 tons in 1935. Details as to type of furnace in which the scrap was charged and geography of ferrous-scrap consumption were also presented.

Legislation directly concerned with the secondary-metal industry in 1936 comprised the law (Public, No. 448, 74th Cong.) requiring that no exports of tin-plate scrap be made from the United States without a license, obtainable now under certain conditions from the Secretary of State. This was described in the Secondary Metals chapter of Minerals Yearbook, 1936, and is referred to in the Secondary Tin section following.

Proposed legislation in 1937 which is of considerable concern to the scrap and secondary-metal industry comprises a bill (H. R. 6322) to provide for cooperation between the United States and foreign nations producing tin ore and other materials to assure to the United States continuing supplies thereof to supplement deficient domestic resources and production, and for other purposes, and a bill (S. 2025) to provide for the protection and preservation of domestic sources of scrap steel.

The former bill would set up a Board for Strategic Materials which would recommend to the President after careful studies what materials should be classified as strategic; the President would then be em-

[3] Lund, R. J., and Davis, H. W., Consumption of Ferrous Scrap and Pig Iron in the United States in 1935: Rept. of Investigations 3329, Bureau of Mines, 1936, 14 pp.
Ridgway, R. H., Davis, H. W., and Trought, M. E., Consumption of Ferrous Scrap and Pig Iron in the United States—1936: Min. Market Rept. M. M. S. 550, Bureau of Mines, May 28, 1937.

powered to declare by Executive order such materials strategic. The Board further would be authorized to study, devise, and suggest ways and means for cooperation between the United States and countries producing strategic materials; it would be authorized to make studies, surveys, tests, etc., for the purpose of developing resources of such materials in the United States or of finding substitutes therefor. Other sections of the act call specifically for an extensive survey of the United States, Alaska, and Hawaii for the purpose of locating and testing possible tin ores and for comprehensive studies on the development of substitutes for tin.

The latter bill, the so-called Schwellenbach bill, would require the licensing of all exports from the United States and Territories of steel-plate scrap.

Another bill, submitted later by Senator Austin, of Vermont, in the form of a resolution, would prohibit exports of iron and steel scrap (including all materials heretofore or hereafter classified as such in official publications of the Bureau of Standards) except upon license issued by the President of the United States.

A bill (H. R. 6621), proposing an amendment to the tin-plate licensing bill of 1936 to include other scrap containing tin together with drosses was still in committee late in May 1937.

Members of the waste-trade industry generally are strongly opposed to these possible export restrictions, and they point out that the high prices for ferrous scrap (which softened materially toward midyear of 1937) actually result in making huge supplies of this material available for use which otherwise would rust away because it could not stand freight charges to consumption or export centers. They also ask why scrap iron and steel should be singled out for export embargoing, when other basic raw materials important in rearmament uses are allowed unrestricted flow. Late in May it was reported [4] that Secretary of State Hull had expressed his opposition to the Schwellenbach bill in letters to the chairman of the Senate and House Military Affairs Committees, pointing out that an interdepartmental committee after careful consideration has "unanimously reached the conclusion that the export movement of scrap has created no emergency situation and that there is no actual or prospective shortage of scrap" * * * and "that the disadvantages of direct or indirect restrictive action would outweigh the possible advantages."

Secondary copper and brass.—The copper produced in 1936 by smelters of secondary material only includes 127,085 tons of pig copper (part of which was electrolytically refined), 119,300 tons of copper in remelted brass, and 105,300 tons of copper in alloys other than brass. These figures indicate increases of 5,557 tons in pig copper, 34,700 tons in copper in brass, and 11,000 tons in copper alloys other than brass. Regular copper smelters produced 15,563 tons less secondary copper in 1936 than in 1935.

The total value of secondary copper as metal and in brass and other alloys, computed at 9.2 cents a pound (the average price in 1936 of all merchantable grades of new metal), was $89,166,400, about $14,649,000 more than in 1935.

Imports of brass scrap decreased from 119 tons in 1935 to none in 1936, and those of copper scrap increased from none in 1935 to 754 tons in 1936. Brass scrap exported decreased 17,453 tons, and copper scrap exported, increased 3,677 tons.

[4] Daily Metal Reporter, May 26, 1937, p. 10.

Secondary copper recovered in the United States, 1935–36 and imports and exports of brass and copper scrap, in short tons

	1935	1936
Copper as metal	[1] 270,000	[1] 260,000
Copper in alloys other than brass	94,300	105,300
	364,300	365,300
Copper from new scrap (not including brass)	45,000	40,000
Copper from old scrap (not including brass)	319,300	325,300
	364,300	365,300
Brass scrap remelted:		
New clean scrap	60,000	88,400
Old scrap	60,800	82,000
	120,800	170,400
Copper content of brass scrap (averaging 70 percent copper):		
New scrap	42,200	61,900
Old scrap	42,400	57,400
	84,600	119,300

	1935	1936
Total secondary copper (including copper content of brass scrap):		
From new scrap	87,200	101,900
From old scrap	361,700	382,700
	448,900	484,600
As metal	270,000	260,000
In brass and other alloys	178,900	224,600
	448,900	484,600
Brass scrap imported	119	---------
Scrap copper imported	---------	754
Brass scrap exported	29,792	12,339
Scrap copper exported	9,547	13,224

[1] Of these totals secondary copper reported by smelters and refiners that treat mainly primary metal comprised 148,478 tons in 1935 and 132,915 tons in 1936.

The terms "new brass scrap" and "new copper scrap", as applied in the preceding table, refer to the scrap that is accumulated in fabricating products; "old scrap" is the metal that was made into products and after service has been discarded and returned to be remelted or refined for further use. Few junkmen, dealers, or smelters keep any statistics of "old scrap" and "new scrap". Most of the new scrap is clippings, grindings, and defective articles made in the ordinary operations in fabricating goods, some of which is reused at the plant and the remainder sold. All foundries (many of which purchase scrap metals) are advised in the Bureau of Mines questionnaire to exclude all scrap made and used in their own plants and to give data solely on purchased scrap. Those that purchase only "new scrap" of certain grades and assay can give correct data; the others usually can make no distinction between "new" and "old" scrap. Secondary smelters usually cannot give exact figures but occasionally can estimate the proportion of "new" scrap metal treated. The figures in the preceding table are the best obtainable.

Reports for 1936 show that railroads reused at their shops and foundries the following quantities of scrap metals: 7,800 tons of brass; 1,020 tons of copper; 11,108 tons of copper in alloys other than brass; 1,400 tons of tin in babbitt, solder, and bronze; and 4,980 tons of lead in various alloys.

Apparently stocks of scrap copper and copper alloys are normal at large dealers' yards, smelters, and foundries. The pick-up by small collectors remote from smelters increased to some extent during the last 3 months of 1936. Urban collections from fabricating plants usually were marketed quickly.

The use of various alloys (ordinarily in small quantities) in the manufacture of brass is becoming more prevalent. It is thought that purchasing agents will be required to specify more closely in order to obtain the type of metal desired.

Secondary lead.—The output of secondary lead in 1936 equaled 66 percent of the total production of refined primary lead from domestic and foreign sources in the United States, compared with 83 percent in 1935. Much recovered lead is derived from discarded batteries, pipe, sheet, and lead-covered cable; other sources are solder, babbitt, and shot.

Secondary lead recovered by smelters whose product is mainly primary metal decreased 10,192 tons in 1936. The output of pig lead by secondary smelters decreased about 9,108 tons, and that of lead in scrap alloys increased 8,349 tons.

Old batteries were collected in 1936 at a rate equal to that in 1935. Collections were good in urban but only fair in rural areas. In the closely populated areas apparently dealers did not accumulate battery plates or old batteries but unloaded them as fast as purchased, so that scrap batteries available were those actually taken in current trade. The higher price of lead now prevailing doubtless will increase the quantity of old batteries marketed from midwestern and mountain areas, although this will not add appreciably to the smelter receipts. Recovery of battery plates will increase in 1937 owing to the increased scrapping of old cars.

Secondary lead recovered in the United States, 1935–36, in short tons

	1935	1936
Secondary lead recovered by smelters that treat mainly ore	44,748	34,556
Secondary lead recovered by smelters that treat only scrap and drosses	112,052	102,944
	156,800	137,500
Secondary lead recovered in remelted alloys:		
Estimated secondary lead content of antimonial lead produced at regular lead smelters [1]	9,479	12,930
Lead content of drosses and scrap alloys treated at secondary smelters	104,121	112,470
	113,600	125,400
Total secondary lead recovered	270,400	262,900

[1] Antimonial lead produced at primary smelters totaled 16,384 tons containing approximately 4,685 tons of primary domestic lead, 491 tons of primary foreign lead, 1,110 tons of primary domestic antimony, 26 tons of primary foreign antimony, 9,479 tons of secondary lead and 593 tons of secondary antimony in 1935, compared with 23,230 tons containing approximately 7,442 tons of primary domestic lead, 696 tons of primary foreign lead, 1,434 tons of primary domestic antimony, 37 tons of primary foreign antimony, 12,930 tons of secondary lead, and 691 tons of secondary antimony in 1936.

Refined primary lead produced in the United States, 1935–36, in short tons

	1935	1936
From domestic ore	310,505	387,698
From foreign ore and base bullion	14,055	11,458

A number of secondary smelters treating old batteries and other lead alloys now recover much of the lead as good-grade pig lead. The residues and drosses containing antimony are then used in making hard lead containing various percentages of antimony.

Some of the problems in handling old batteries are stated in an article by Neuman.[5]

[5] Neuman, E. A., Journey of Battery Plates from Dealer to Consumer: Waste Trade Jour., Mar. 27, 1937, pp. 89, 94.

The question of the prices paid for battery plates is discussed in an article by Schoenback.[6]

The sampling of battery plates is much more difficult than the assaying, due to the moisture in the rubber and separators.

A large number of the old batteries are smelted on toll by custom smelters. The smelters also purchase batteries at a price based on that of pig lead at St. Louis, the antimony content being paid for at the price of lead, although the price of antimony in 1936 was about three times that of lead.

Secondary zinc.—Secondary zinc recovered as pig metal and in alloys (including brass) increased 27,750 short tons, largely in redistilled zinc and zinc in brass. The zinc content of brass remelted was 12,600 tons more in 1936 than in 1935. The total recovery of secondary zinc (including that in brass) equaled 25 percent of the total output of primary slab zinc in the United States (492,132 tons) in 1936. In addition, large quantities of the zinc dust, zinc chloride, and other compounds were made from zinc drosses and residues.

Secondary zinc [1] recovered in the United States, 1935–36, and products made from zinc dross, skimmings, and ashes, in short tons

	1935	1936
Secondary zinc recovered by redistillation	28,650	42,209
Secondary zinc recovered by sweating, remelting, etc	26,750	25,791
Total zinc recovered unalloyed	55,400	68,000
Zinc recovered in alloys other than brass	8,950	11,500
Zinc recovered in brass (estimated)	30,000	42,600
Zinc dust made from zinc dross	12,453	14,425
Zinc dross used for zinc dust (estimated)	14,950	17,150
Zinc concentrates and ore exported; Zinc dross exported	461	245
Lithopone made from zinc skimmings and ashes	[2] 68,341	67,361
Secondary zinc content of lithopone	13,512	13,450
Zinc chloride made from zinc skimmings, ashes, etc	(3)	(3)
Zinc content of zinc chloride made from zinc skimmings, etc	(3)	(3)
Zinc content of zinc sulphate made from zinc skimmings, ashes, etc	483	1,224
Zinc oxide produced from zinc scrap and drosses	9,452	11,600

[1] Figures do not include scrap and dross used for lithopone or chloride. The use for zinc chloride, especially, is large.
[2] Revised figure.
[3] Figures not available.

Zinc recovered by redistillation increased from 28,650 tons in 1935 to 42,209 in 1936. Of the 1936 total, 22,142 tons (an increase of 8,703 tons) were recovered at primary smelters from zinc drosses and 20,067 (an increase of 4,856 tons) at five secondary plants using large graphite retorts and two plants using clay retorts, which treated only drosses and residues in 1936. The five active smelters using large graphite retorts in 1936 were:

Federated Metals Corporation, Trenton, N. J.
General Smelting Co., Philadelphia, Pa.
Nassau Smelting & Refining Co., Tottenville, N. Y.
Superior Zinc Corporation, Bristol, Pa.
Wheeling Steel Corporation, Wheeling, W. Va.

Of the total output of 163,340 tons of lithopone in 1936, 67,361 containing 13,450 tons of zinc were made from zinc skimmings and ashes.

[6] Schoenback, Walter, Pyramiding Battery Plate Prices: Waste Trade Jour., Mar. 28, 1936, p. 97.

The American Bureau of Metal Statistics estimates that 242,000 tons of zinc (47,000 more than in 1935) were used in 1936 in zincking (galvanizing) sheets, forms, tubes, wire, and other materials.

Secondary tin.—Secondary tin recovered amounted to 28,020 tons valued at $25,621,500 in 1936, compared with 27,900 tons valued at $27,498,200 in 1935. The total value assigned is based on the yearly average price (45.72 cents in 1936 and 49.28 cents in 1935) given by the American Metal Market for 99-percent metal, prompt delivery at New York.

The 1935 and 1936 figures for recovery of pig tin are not comparable, as in 1936 it was decided to eliminate from secondary-tin figures all tin recovered at tin-plate plants by operators by treating tin scruff. This tin is recovered in the ordinary course of operations at nearly all plants, and its elimination decreased 1936 totals about 2,000 tons. The tin recovered in 1936 in alloys and chemical compounds increased 2,470 tons. Secondary tin recovered in 1936 was equivalent to about 33 percent of the tin imported into the United States as pig metal in 1936.

According to the American Iron and Steel Institute 2,355,561 long tons of tin plate and terneplate were made in 1936. It is estimated that about 40,000 long tons (an increase of 25 percent) of tin were used in these products and that 4,265 short (3,808 long) tons of tin were recovered from tin-plate clippings and old coated containers.

Owing to the relatively high value of tin, it is important that the degree of accuracy be high in obtaining representative samples of shipments of tin dross and in analyzing them later.[7]

Many earlier chapters of this series contain data on plants and processes followed, and a complete history of the different methods of detinning has been published by Mantell.[8]

Under the Act of Congress passed February 1936, "To provide for the protection and preservation of domestic sources of tin", and the subsequent Executive order issued by the President of the United States, it is necessary to obtain a license from the Secretary of State for all exports of tin-plate scrap. According to a press release of the Department of State, January 4, 1937, the Department received applications for license to export 23,383 long tons of tin-plate scrap between July 1 and December 31, 1936. Forty-nine licenses, authorizing the exportation of 6,483 long tons of tin-plate scrap valued at $106,854, were issued during that period. All of these licenses were for export to Japan.

Allotments have been assigned to 39 producers for export of 18,609 long tons of tin-plate scrap, subject to license, during the early part of 1937; applications for allotments in 1937 have totaled 27,752 long tons.

An amendment to the act has been proposed requiring an export license for shipping tin-plate scrap to Hawaii and Puerto Rico to prevent reexportation to ultimate consumers. The waste-material industry is much disturbed over the proposed embargo on scrap-iron and steel exports and over a bill introduced on April 12, 1937, which seeks to provide for cooperation between the United States and foreign nations producing tin ore and other materials "to assure the United States continuing supplies of the same to supplement deficient domestic resources and production, and for other purposes." The industry

[7] Kasey, J. B., A Suggested Method of Preparing Deliquescent Tin Dross Samples: Met. Ind., September 1936, p. 338.

[8] Mantell, C. L., Scrap Detinning Affords Big Outlet for Chlorine: Chem. and Met. Eng., 1926, pp. 477–479.

does not like the words "for other purposes." It feels that the restrictions on the export of tin-plate scrap may be extended to all scrap containing even small quantities of tin, as provided for in a bill (H. R. 6621, 75th Cong. 1st sess.) still in committee late in May, and perhaps to scrap containing antimony, nickel, chrome, cobalt, and other so-called strategic metals.

The proposed embargo on iron and steel scrap would affect the export of various alloy steels that contain metals not mined in the United States in sufficient quantities to supply domestic uses.

Although the average yearly price of tin declined, it remained close to 46 cents a pound in 1936 and resulted in the detinning of old tin-coated containers (about 3,300 tons) for the third time in many years. The old cans yield much less tin than clean tin-plate clippings. Many more old cans will be treated at the plants now equipped to handle them, but the high cost of collecting and shipping them militates against their use. There are also the additional costs of cleaning and handling bulky material. Thus the use of old tin-coated containers probably will be confined to areas adjacent to the detinning plants.

Secondary tin recovered in the United States, 1935–36

	1935	1936
Tin recovered as pig tin .... short tons..	9,600	7,250
Tin recovered in alloys and chemical compounds .... do....	18,300	20,770
	27,900	28,020
Clean tin-plate scrap treated at detinning plants .... long tons..	193,571	228,209
Metallic tin recovered at detinning plants .... pounds..	2,413,081	5,128,424
Tin content of tin tetrachloride, tin bichloride, tin crystals, and tin oxide made at detinning plants .... pounds..	4,886,479	3,401,477
Total tin recovered at detinning plants .... do....	7,299,560	8,529,901
Tin tetrachloride, tin bichloride, tin crystals, and tin oxide made at detinning plants .... pounds..	10,434,540	6,887,121
Average quantity of tin recovered per long ton of clean tin-plate scrap .... do....	37.7	7.4

Tin (metal) and tin concentrates (tin content) imported into the United States, 1935–36, in short tons

	1935	1936
Tin imported as metal	71,969	85,153
Tin concentrates (tin content) imported	199	200

The quantity of tin-plate clippings treated at detinning plants increased about 34,600 long tons in 1936, and the average cost of such clippings delivered at plants increased from $14.73 a long ton in 1935 to $14.80 in 1936. These clippings were treated at plants of the Vulcan Detinning Co. at Sewaren, N. J., Neville Island, Pa., and Streator, Ill.; of the Johnston & Jennings Co. of Cleveland, Ohio; and of the Metal & Thermit Co., at South San Francisco, Calif., East Chicago, Ind., and Chrome, N. J.

Imports of tin-plate scrap in 1936 totaled 9,873 long tons valued at $94,049, compared with 9,185 tons valued at $68,109 in 1935. Of these amounts, Canada supplied 9,275 tons valued at $89,247 in 1936 and 8,794 tons valued at $65,581 in 1935. Cuba supplied the remainder in both years.

Exports of tin-plate scrap decreased from 34,928 long tons valued at $749,604 in 1935 to 14,375 valued at $282,214 in 1936. Japan took about 91 percent of the total in 1935 and about 95 percent in 1936. The total quantity exported in 1936 after the export ban and licensing provisions became effective (Apr. 14, 1936) was 5,550 long tons, according to monthly export statistics published by the Bureau of Foreign and Domestic Commerce. This material would yield Japanese detinners about 35 pounds of tin per long ton.

Exports of waste tin plate increased from 24,525 long tons valued at $1,449,008 in 1935 to 44,621 tons valued at $2,635,662 in 1936, of which Japan took about 85 percent in 1935 and about 77 percent in 1936.

The tin reported recovered in alloys and compounds in 1936 included the tin content of products made from clean tin-plate scrap. Most of the tin recovered at the plants listed was in tin bichloride, tin crystals, tin tetrachloride, and tin oxide.

The total recovery of tin as metal or in compounds from clean tinplate scrap in 1936 was 4,265 short tons, whereas it is estimated that makers of tinplate and terneplate consumed nearly 45,000 short tons of tin. Some old tin-coated containers treated at Sewaren, N. J., yielded 27.76 pounds of tin per long ton.

A plant in Los Angeles collected old cans locally for use in shredded scrap to precipitate copper from mine waters, but there was no attempt to recover the tin coating.

A book by C. L. Mantell, of Pratt Institute, Brooklyn, N. Y., entitled "Tin: Its Mining, Production, Technology, and Application", includes chapters on the sources of secondary tin and the various methods of detinning tin-plate scrap.

Secondary aluminum.—The recovery of secondary aluminum, including that in alloys, totaled 51,500 short tons valued at $19,055,000, compared with 51,400 tons valued at $19,018,000 in 1935. The values in both years were computed at 18.5 cents a pound.

The value of primary aluminum produced in the United States increased from $22,070,000 in 1935 to $41,612,000 in 1936 owing largely to an increase of about 88 percent in output.

Secondary aluminum recovered in the United States, 1935–36, in short tons

	1935	1936
Secondary aluminum recovered unalloyed	23,500	20,900
Aluminum recovered in alloys (mainly No. 12)	27,900	30,600
	51,400	51,500

Primary aluminum produced in the United States and imported and exported, 1935–36, in pounds

	1935	1936
Primary aluminum produced in the United States	119,295,000	224,929,000
Aluminum (crude and semicrude) imported for consumption	21,291,235	25,562,571
Aluminum (crude and semicrude) exported	3,970,347	1,605,753

The spread in scrap-aluminum castings was 1.37 cents a pound in 1936; the demand was usually good, and the quantity available was cleaned up fairly well. Aluminum cylinder heads and aluminum-alloy pistons were used more extensively in motorcars than formerly, so that an increased quantity of scrap aluminum was consumed in the automobile industry. Scrap cast aluminum and old crankcases were in good demand and were somewhat scarce at times. Scrap-aluminum clippings remelted in the ordinary course of shop practice were excluded wherever possible from 1936 recoveries. Nearly 600 tons of aluminum clippings were used in making powdered aluminum in 1936.

Numerous alloys containing aluminum contribute to the secondary aluminum recovered, but No. 12 (a mixture of about 92 percent aluminum and 8 percent copper) constitutes the largest supply of material for remelting and refining. Other alloys are used in smaller quantities. Many automobile aluminum crankcases are sold to foundaries and do not reach the secondary smelters.

The approved standard methods of sampling and analyzing aluminum and its alloys are described in a pamphlet published by the Aluminum Research Institute in July 1932. A book [9] by Anderson is interesting to smelters and users of secondary aluminum.

Prices for scrap cast aluminum ranged from 11.50 cents a pound in August to as high as 12.87 cents in December.

New aluminum clippings ranged in price from a low of 13.25 cents in July to a high of 14.25 cents in January; the average price in 1936 was only 0.46 cent higher than in 1935.

Secondary antimony.—The principal materials refined or remelted that contained antimony as an alloy were hard-lead drosses, babbitt, bearing metal, battery plates, pewter, and type metal. The antimony used in the pigment, paint, and ceramic industries is so dissipated that no secondary recoveries can be made, but a large proportion of the production of metal containing antimony returns in a few months or a few years for refining and reuse. Antimony in type metal and in bearings returns very rapidly for refining. This large return of scrap in type and bearing metals normally goes to the makers of type and bearing alloys, which restricts the market for antimonial lead. It may take several years for antimony in battery plates to return as scrap, but probably 85 percent is certain to come back for reuse.

The production of secondary antimony in the United States, most of which was recovered in alloys, increased in 1936. The average price for ordinary brands (Chinese grade) of antimony, as stated by the American Metal Market, was 12.97 cents a pound in 1936 compared with 14.08 cents in 1935. Smelters that ordinarily use primary ores, concentrates, or metal reported 1,471 tons of primary antimony and 691 tons of secondary antimony as contained in 23,230 tons of antimonial lead. The recovery of secondary antimony by secondary smelters increased about 200 tons.

Imports of antimony in ore, as metal, or in oxide were 6,304 tons more than in 1935.

[9] Anderson, R. J., Secondary Aluminum: Sherwood Press, Inc., Cleveland, Ohio, 1931, 563 pp.

Secondary antimony recovered in and antimony imported into and exported from the United States, 1935–36, in short tons

	1935	1936
Secondary antimony in antimonial lead scrap smelted at regular smelters	593	691
Secondary antimony recovered at secondary smelters	9,007	9,209
	9,600	9,900
Antimony imported in ore, as metal, or as oxide or salts	7,814	14,118
Foreign antimony exported	318	391

Secondary nickel.—The nickel reported as recovered from secondary sources includes nickel in Monel metal (the natural alloy) but not that in ferrous alloys. The practice of using small quantities of nickel in iron and steel as well as in brasses and bronzes expanded greatly in both 1935 and 1936. Activity was much greater at foundries in 1936, and a large part of their products contained some nickel.[10]

Nickel was often substituted for tin to lower costs in certain alloys requiring tensile strength and ductility.

Most of the secondary nickel recovered in 1936 came from scrap-nickel anodes, nickel-silver, copper-nickel alloys, and Monel metal. Exports of nickel scrap and scrap alloys containing nickel increased. It is impossible to give the nickel content of all the exports of such nickel-bearing scrap, but the total nickel content reported by exporters who submitted data to the Bureau of Mines was 1,262 tons in 1936 and 960 in 1935.

The secondary nickel recovered in ferrous alloys was undoubtedly much larger in 1936 than in 1935. It is estimated by Robert C. Stanley, president of the International Nickel Co., Ltd., that about 42 percent of all nickel consumed in the United States is used in nickel iron and steel, mainly in motor cars, railway equipment, heat-resistant alloys, and machinery. All these industries expanded greatly in 1936. Probably more secondary nickel is recovered from ferrous than from nonferrous alloys, but no figures are available. Certain alloys give uninformed dealers trouble.[11]

Scrap iron and steel dealers are frequently careless in handling alloy ferrous scrap, and certain discarded equipment and automobile scrap which contain nickel are thrown in with the regular steel scrap instead of being kept separate and advantage taken of their greater value.[12]

Secondary nickel recovered in the United States, 1935–36, in short tons

	1935	1936
Nickel recovered as metal	700	855
Nickel recovered in nonferrous alloys and salts	1,250	1,110
	1,950	1,965

[10] Curry, D. M. (International Nickel Co.), Nickel in Brass-Foundry Practice: Met. Ind., 1936, pp. 430 and 432.
[11] Edelstein, Joel, Nickel Alloys in Scrap Metals: Waste Trade Jour., Mar. 27, 1937, pp. 83 and 87.
[12] Walenchik, I. W., Profits in Nickel Alloys: Waste Trade Jour., Mar. 27, 1937, p. 147.

Primary nickel produced in the United States and imported and exported, 1935–36, in short tons

	1935	1936
Nickel produced as a byproduct from the electrolytic refining of copper at domestic refineries	160	107
Nickel imported for consumption in the United States as nickel or in nickel ores and matte, oxide, and alloys	37,848	53,136
Nickel, Monel metal, and other alloys exported	1,726	3,438

Considerable information as to the composition and uses of nickel, Monel metal, and other nickel alloys is given in Inco and in special pamphlets on nickel and its various alloys, publications of the International Nickel Co. This company purchases nickel scrap and Monel scrap.

CLASSIFICATION OF OLD METALS

The classification of old metals drawn up by the Metals Division of the National Association of Waste Material Dealers, Inc., Times Building, New York, N. Y., and changed from time to time as desirable, is the standard of both dealers and manufacturers in the United States. The latest classification (Circ. M), effective March 16, 1932, was given in the Secondary Metals chapter, Minerals Yearbook, 1936. No immediate changes are contemplated in this classification.

There is a growing demand for scrap-metal specialties (not specifically covered by the classification), such as nickel alloys, German silver, Monel metal, cadmium, and molybdenum. Difficulties have arisen in making shipments to buyers' specifications, and with the object of eliminating some of the trouble the Waste Trade Journal published classifications used by one of its advertisers. A list of these was given on pages 338 and 339 of the Secondary Metals chapter in Mineral Resources of the United States, 1930, part I.

IRON ORE, PIG IRON, FERRO-ALLOYS, AND STEEL

By Robert H. Ridgway and H. W. Davis [1]

SUMMARY OUTLINE

Preliminary data indicate that world production of steel established a new high level in 1936, and that the output of pig iron, with an increase of 23 percent over 1935, was topped only by the record figure for 1929. Requirements accumulated from preceding depression years, together with the almost frantic armament race under way among the principal world powers, have imposed enormous demands upon the iron and steel industries. Of the total world output of pig iron and steel in 1936, the United States furnished about 34 and 40 percent, respectively.

In 1936 the American iron and steel industry increased its annual output for the fourth successive year; in fact, the production of steel and pig iron rose 40 and 45 percent, respectively—much larger relative gains than in 1935. The increase in domestic output of steel and of pig iron in 1936 over 1935 was greater than the total production in 1932. This larger output, which gained momentum during the year, required 61 and 68 percent, respectively, of the potential capacity. At the close of 1936 operations were definitely on a larger scale than

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

during the opening months, as the average rate of production in the first quarter was only 55 percent of capacity. The higher rate of operation reacted to the benefit of producers of such mineral products as iron ore, manganiferous iron ore, fluorspar, fluxing stone, and coke, which depend on the iron and steel furnaces for their chief market. Domestic production of iron ore, the principal raw material, increased 60 percent over 1935, and totaled 48,788,745 gross tons in 1936. The trends in domestic production of iron ore, pig iron, and steel for more than half a century are illustrated in figure 31.

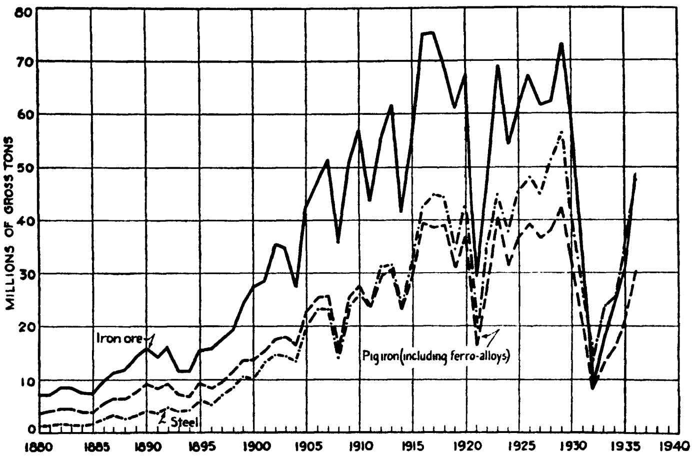


FIGURE 31.—Trends in production of iron ore, pig iron, and steel in the United States, 1880–1936.

Salient statistics of iron ore, pig iron, ferro-alloys, and steel in the United States, 1935–36

	1935		1936	
	Gross tons	Value	Gross tons	Value
Iron ore:				
Production by—				
Districts:				
Lake Superior [1]	25,368,637		41,781,215	
Southeastern	3,295,684	(2)	4,214,587	(2)
Northeastern	1,349,247		2,069,764	
Western	526,684		723,179	
	30,540,252	(2)	48,788,745	(2)
Mining methods:				
Open pit	[3] 17,926,848	(2)	[3] 30,803,244	(2)
Underground	[3] 12,613,404		[3] 17,985,501	
	30,540,252	(2)	48,788,745	(2)
Varieties:				
Hematite	[4] 28,920,328		[4] [5] 46,107,680	
Brown ore	267,183	(2)	[5] 474,889	(2)
Magnetite	[4] 1,352,054		[4] 2,205,643	
Carbonate	687		533	
	30,540,252	(2)	48,788,745	(2)
Shipments (exclusive of ore for paint)	33,426,486	$83,034,561	51,465,648	$131,740,594
Average value per ton at mine		2.48		2.56
Stocks at mines	7,786,725	(2)	5,441,608	(2)
Imports	1,492,435	3,482,438	2,232,229	5,280,197
Exports	660,553	1,913,463	645,284	1,962,527

See footnotes at end of table.

Salient statistics of iron ore, pig iron, ferro-alloys, and steel in the United States, 1935-36—Continued

	1935		1936	
	Gross tons	Value	Gross tons	Value
Pig iron:				
Production	20,827,196	(2)	30,254,022	(2)
Shipments	21,178,353	358,145,499	30,798,958	541,693,504
Average value per ton at furnaces		16.91		17.59
Imports	130,937	1,979,324	165,808	2,336,236
Exports	4,107	96,272	5,316	119,362
Ferro-alloys:				
Production	545,316	(2)	818,488	(2)
Shipments:				
Ferromanganese	194,627	16,374,328	322,353	24,088,298
Spiegeleisen	54,793	1,303,574	92,336	2,249,217
Ferrosilicon	263,264	11,630,793	325,210	15,176,800
Other varieties	79,492	19,582,897	113,632	27,620,759
	592,176	48,891,592	853,531	69,135,074
Imports:				
Ferromanganese	27,240	1,731,411	37,953	2,251,951
Spiegeleisen	32,384	915,134	52,011	1,404,983
Ferrosilicon	5,274	135,422	3,823	78,566
Steel production:				
Open hearth:				
Basic	30,361,237	(2)	43,114,826	(2)
Acid	354,192		421,302	
Bessemer	2,835,031		3,458,457	
Crucible	642		816	
Electric	541,492		772,455	
	34,092,594	(2)	47,767,856	(2)

1 Includes a small quantity of ore produced in southern Wisconsin.
2 Figures not available.
3 Some open pit included with underground.
4 Some hematite included with magnetite.
5 Some brown ore included with hematite.

The automotive industry in 1936, with an output of 4,454,535 cars, the largest since 1929, remained the chief consuming outlet for steel, taking one-fifth of the total output compared with one-fourth in 1935. Despite the increased farm income, relative and actual amounts of steel moving into agricultural outlets declined in 1936. Although the relative amount of steel going into containers dropped, consumption in this outlet increased moderately.

Revival in the capital-goods industries was paced by the increased proportion of steel absorbed by these industries. Demand by the railroads for larger amounts of steel was most striking in 1936, but the volume so consumed was still far less than in the twenties. The strict economy practiced by the railroads during the depression built up a back log of orders that is now being tapped. The demand not only includes materials needed to replace worn-out or scrapped equipment but also to build the new, high-speed, streamlined units for passenger service, necessitated by keen competition with other railroads as well as with motor and airplane transportation. For example, new, 12-car, stainless-steel, streamlined, air-conditioned trains make the run of 1,035 miles between Chicago and Denver in 16 hours.

The construction industry, though still lagging, took relatively more steel in 1936 than in 1935. A sharp increase in industrial construction was noted during the year. Residential building also advanced substantially but still remained far below the predepression level. The amount of steel consumed in machinery and highway construction likewise increased in 1936.

General price advances were noted during 1936, particularly for the fourth quarter, when there was a large volume of buying. At the end of the year the composite price of finished steel, as compiled by Iron Age, was 2.330 cents a pound, which was higher than the 1929 peak of 2.317 cents per pound. The prices for the various grades of pig iron advanced during the last 2 months of the year, but that for spiegeleisen remained steady. The price of ferromanganese, which dropped $10 a ton to $75 a ton in January as a result of the lower tariff under the trade agreement with Canada, was increased $5 a ton in November. A particularly interesting development during 1936 was the adoption of a system of open-price announcements by the steel industry. Under this arrangement, the seller announces prices to the customer and agrees to notify him of any change. Open prices were in effect under the N. R. A. Steel Code, but when the code was abandoned the industry reverted to its former practices. Recent Federal legislation forbidding discrimination in prices to customers is expected to aid in maintaining open prices.

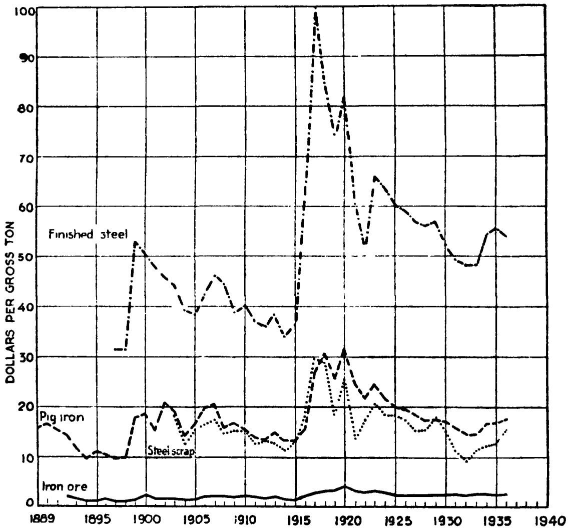


FIGURE 32.—Trends in prices of iron ore, pig iron, finished steel, and steel scrap, 1889–1936. The prices of iron ore and pig iron are the averages f. o. b. mines and furnaces, respectively, as reported to the Bureau of Mines; the price of finished steel is an average composite computed by American Metal Market; that of steel scrap is an average at Pittsburgh of No. 1 Heavy Melting computed by Iron Age.

Employee relationships in recent years have received more attention from managers of steel-producing industries. The number of employees increased materially during 1936 and exceeded that in 1929. Despite extensive mechanization, more man power is required to produce the great variety of finished steels now demanded. Vacations with pay for millworkers were instituted recently by many companies, and increases in wage rates were noted during the year.

Considerable new capacity was added to producing plants in 1936, and it is planned to add more in 1937. Such additional capacity was largely in the finishing end of the steel processes to meet the increased demand for certain types of products and to correct overbalanced capacity in other lines. Eight new open hearths were added in 1936, but no new blast furnaces were built, although several were remodeled

and enlarged. In fact, no new blast furnaces have been built since 1928, and many obsolete stacks have been dismantled and scrapped.

Imports of iron ore and pig iron into the United States were higher in 1936, and exports of iron ore decreased slightly. Exports of pig iron, which are very small, increased. Imports of ferro-alloys increased in 1936 over 1935, and exports, which are relatively unimportant, also were larger. Increases were noted in exports of a wide range of steel products, particularly tin plate, but scrap shipments abroad were slightly lower. Imports of steel products, which are relatively small, increased, and imports of scrap doubled.

Tariff changes.—Changes in the import duty on a number of iron and steel products have been made during 1935 and 1936 under the Trade Agreements Act of June 12, 1934. Such charges will be found in the Swedish Agreement effective August 5, 1935, the Canadian Agreement effective January 1, 1936, the Swiss Agreement effective February 15, 1936, the Belgian Agreement effective May 1, 1935, and the French Agreement effective June 15, 1936.

CONSUMPTION OF FERROUS SCRAP AND PIG IRON

Domestic consumption of iron and steel scrap totaled 36,469,000 gross tons in 1936, an increase of 38 percent over the 26,415,330 tons consumed in 1935, while pig-iron consumption in 1936 was 29,778,000 tons, or 44 percent more than in 1935, when 20,620,463 tons were consumed. Preliminary statistics given herein for the consumption of ferrous materials in 1936 are based on reports from concerns that use over 95 percent of the total consumption.

Of the 1936 total, 18,860,000 gross tons were home scrap and 17,609,000 tons purchased scrap. As employed in this report, the term "home" or "plant" scrap refers to scrap produced at the plant of the establishment reporting and includes (1) new scrap such as spills, risers, skulls, croppings, mill scale, cinder, etc., and (2) old scrap (any items of equipment discarded after actual use). The term "purchased scrap" includes both purchases and scrap transferred from other plants under the same control as well as scrap received under exchange contracts or conversion agreements. The ratio of total scrap consumption to pig-iron consumption in 1936 was 1:0.82 compared with 1:0.78 in 1935, while the ratio of purchased scrap to pig-iron consumption was 1:1.69 compared with 1:1.58 in 1935 and the ratio of home scrap to pig-iron consumption was 1:1.58 in 1936 compared with 1:1.54 in 1935.

The use of scrap as a raw material in the manufacture of steel increased 38 percent over 1935, and the quantity of pig iron charged directly to steel furnaces increased 46 percent. Likewise, the increase in use of home scrap was greater than that of purchased scrap. The net effect of the relatively greater use of pig iron and home scrap in 1936 was to reduce slightly the proportion of purchased scrap in ferrous materials charged to steel furnaces from 26.4 percent of the total in 1935 to 24.6 percent in 1936.

Salient statistics on the consumption of ferrous scrap and pig iron in the United States, 1935–36

	1935	1936	Percent of change in 1936
Total ferrous scrap consumed gross tons	26,415,330	36,469,000	+38
Home scrap do	13,346,752	18,860,000	+41
Purchased scrap do	13,068,578	17,609,000	+35
In iron furnaces [1] do	6,160,830	8,731,000	+42
In steel furnaces [2] do	20,254,500	27,738,000	+37
Pig iron consumed in steel furnaces do	17,520,144	25,620,000	+46
Total ferrous materials charged to steel furnaces do	37,774,644	53,358,000	+41
Home scrap percent of total	27.2	27.4	
Purchased scrap do	26.4	24.6	
Pig iron do	46.4	48.0	
Ferrous scrap exported gross tons	2,103,959	1,936,132	−8
Price per gross ton:			
Scrap [3]	$12.73	$15.84	+24
Pig iron [4]	$18.17	$19.10	+5

[1] Includes blast, cupola, air, puddling, and crucible furnaces.
[2] Includes open-hearth, bessemer, and electric furnaces.
[3] No. 1 heavy melting at Pittsburgh.
[4] Basic pig iron f. o. b. Valley furnaces.

Open-hearth furnaces take most of the scrap used in the United States; in 1936 they consumed 26,290,000 gross tons (72 percent of the total) compared with 19,119,627 tons (also 72 percent) in 1935.

Consumption of ferrous scrap and pig iron in the United States, 1935–36, by type of furnace

Type of furnace	Number of active plants reporting	Scrap: Home (gross tons)	Scrap: Purchased (gross tons)	Scrap: Total (gross tons)	Pig iron (gross tons)
1935					
Open-hearth	127	9,589,017	9,530,610	19,119,627	13,944,239
Bessemer	30	212,862	6,452	219,314	3,542,719
Electric	217	464,783	450,776	915,559	33,186
Cupola	2,287	1,916,835	2,241,788	4,158,623	2,675,827
Air	115	278,140	168,103	446,243	295,008
Crucible	10	244	609	853	566
Puddling	5	1,371	4,020	5,391	13,492
Blast	67	883,500	666,220	1,549,720	
	[1] 2,858	13,346,752	13,068,578	26,415,330	[2] 20,505,037
1936					
Open-hearth	134	13,747,000	12,543,000	26,290,000	21,960,000
Bessemer	30	228,000	13,000	241,000	3,636,000
Electric	225	629,000	578,000	1,207,000	24,000
Cupola	2,300	2,650,000	3,350,000	6,000,000	3,639,000
Air	120	418,000	214,000	632,000	384,000
Crucible	10	5,000	8,000	13,000	30,000
Puddling	6				
Blast	75	1,183,000	903,000	2,086,000	
	[1] 2,900	18,860,000	17,609,000	36,469,000	[2] 29,673,000

[1] Where 2 or more separate departments, such as blast-furnace department, open-hearth department, foundry department, etc., are at the same place and are operated by 1 establishment, each of these departments appears as a plant in the total.
[2] In addition, in 1935, 115,426 tons and in 1936, 105,000 tons were reported consumed in direct castings.

Complete data on the regional consumption of ferrous materials for 1936 are not available at this time, but distribution of quantities used in open-hearth, bessemer, and blast furnaces, which took 78 percent of the total scrap and 86 percent of the pig iron consumed in 1936, are shown below:

Consumption of ferrous scrap and pig iron in open-hearth, bessemer, and blast furnaces in 1936, by districts and States, in gross tons

District and State	Open hearth			Bessemer			Blast furnace	
	Scrap		Pig iron	Scrap		Pig iron	Scrap	
	Home	Purchased		Home	Purchased		Home	Purchased
New England and Middle Atlantic:								
Connecticut								
Rhode Island	53,000	232,000	41,000					
Massachusetts							43,000	96,000
New York								
New Jersey	733,000	633,000	1,207,000	1,000	1,000	1,000		
Delaware								
Pennsylvania	3,965,000	3,160,000	7,251,000	65,000	1,000	1,041,000	306,000	183,000
Southeastern and Southwestern:								
Alabama							172,000	45,000
Georgia	351,000	454,000	993,000					
Oklahoma								
District of Columbia	1,000							
Kentucky								56,000
Maryland	1,104,000	1,126,000	1,753,000				53,000	6,000
West Virginia				24,000	1,000	247,000	20,000	9,000
Texas								
Louisiana								
North Central:								
Illinois	1,235,000	1,167,000	1,682,000	2,000	3,000	452,000	111,000	42,000
Indiana	2,000,000	1,447,000	3,141,000	19,000		176,000	31,000	2,000
Michigan	463,000	523,000	730,000				47,000	100,000
Minnesota				1,000	2,000			
Missouri	114,000	491,000	41,000					
Wisconsin								
Iowa								5,000
Ohio	3,435,000	2,628,000	4,741,000	116,000	5,000	1,719,000	390,000	355,000
Pacific Coast and Rocky Mountain:								
California								
Washington	293,000	682,000	380,000					
Colorado							10,000	4,000
Utah								
	13,747,000	12,543,000	21,960,000	228,000	13,000	3,636,000	1,183,000	903,000

In 1935 Ohio led all States in total consumption of scrap, with about 24 percent of the total home scrap, 23 percent of purchased scrap, and 25 percent of the pig iron consumed; Pennsylvania was a close second, with about 24 percent of the home scrap and 19 percent of the purchased, and ranked first in pig-iron consumption, using about 26 percent. Indiana and Illinois followed with about 10 percent each, while Michigan and Wisconsin together took a little less than 10 percent.

Total consumption of ferrous scrap and pig iron in the United States in 1935, by districts and States

District and State	Number of active plants reporting	Scrap: Home: Gross tons	Scrap: Home: Percent of total	Scrap: Purchased: Gross tons	Scrap: Purchased: Percent of total	Scrap: Total: Gross tons	Scrap: Total: Percent of total	Pig iron: Gross tons	Pig iron: Percent of total
New England:									
Connecticut	62	39,936	0.30	99,090	0.76	139,026	0.53	60,884	0.30
Maine	19	5,236	.04	6,070	.05	11,306	.04	6,185	.03
New Hampshire	16								
Massachusetts	105	96,966	.72	196,796	1.50	293,762	1.11	75,991	.37
Rhode Island	15								
Vermont	15	2,270	.02	3,265	.02	5,535	.02	3,596	.02
	232	144,408	1.08	305,221	2.33	449,629	1.70	146,656	.72
Middle Atlantic:									
Delaware	5	101,205	.76	160,472	1.23	261,677	.99	144,114	.70
New Jersey	87								
New York	222	540,082	4.05	587,479	4.49	1,127,561	4.27	818,919	3.99
Pennsylvania	452	3,162,000	23.69	2,453,167	18.77	5,615,167	21.26	5,375,651	26.22
	766	3,803,287	28.50	3,201,118	24.49	7,004,405	26.52	6,338,684	30.91
Southeastern:									
Alabama	68	407,021	3.05	343,190	2.63	750,211	2.84	912,763	4.45
District of Columbia	4	7,177	.05	35	.63	7,212	.03	2,441	.01
Florida	15	46,099	.34	82,219		128,318	.49	32,905	.16
Georgia	41								
Kentucky	22	220,038	1.65	425,061	3.25	645,099	2.44	307,037	1.50
Maryland	27	805,832	6.04	800,417	6.12	1,606,249	6.08	1,497,930	7.30
West Virginia	29								
Mississippi	11	323		939		1,262		200	
North Carolina	33	2,700	.03	13,012	.12	15,712	.07	7,951	.05
South Carolina	15	985		1,867		2,852		1,472	
Tennessee	45	77,496	.58	81,856	.63	159,352	.60	102,665	.50
Virginia	60								
	370	1,567,671	11.74	1,748,596	13.38	3,316,267	12.55	2,865,364	13.97
Southwestern:									
Arkansas	10	4,920	.04	22,861	.17	27,781	.11	987	
Oklahoma	21								
Louisiana	22	4,504	.03	12,623	.10	17,127	.06	366	.02
Texas	45	11,498	.09	39,864	.31	51,362	.20	3,657	
	98	20,922	.16	75,348	.58	96,270	.37	5,010	.02
North Central:									
Illinois	208	1,200,799	9.00	1,224,845	9.37	2,425,644	9.18	1,778,033	8.67
Indiana	118	1,520,500	11.39	1,347,732	10.31	2,868,232	10.86	2,406,179	11.74
Iowa	49								
Minnesota	61	165,599	1.24	491,161	3.76	656,760	2.49	100,894	.49
Missouri	54								
Kansas	32	10,102	.08	29,531	.23	39,633	.15	3,188	.02
Nebraska	14								
Michigan	170	1,401,173		1,066,099		2,467,272		1,349,916	
Wisconsin	127		10.50		8.16		9.34		6.58
North Dakota	2	109		169		278		5	
South Dakota	1								
Ohio	305	3,191,775	23.91	3,001,504	22.97	6,193,279	23.44	5,228,516	25.50
	1,141	7,490,057	56.12	7,161,041	54.80	14,651,098	55.46	10,866,731	53.00
Rocky Mountain:									
Arizona	8								
Nevada	4	5,373	.04	6,248	.05	11,621	.04	48	
New Mexico	1								.82
Colorado	22	100,618	.75	114,424	.88	215,042	.82	167,818	
Utah	14								
Idaho	1	24	.03	96	.03	120	.03	----------	-----
Wyoming	2								
Montana	6	3,781		4,491		8,272		6,641	.03
	58	109,796	.82	125,259	.96	235,055	.89	174,507	.85

Total consumption of ferrous scrap and pig iron in the United States in 1935, by districts and States—Continued

District and State	Number of active plants reporting	Scrap						Pig iron	
		Home		Purchased		Total			
		Gross tons	Percent of total	Gross tons	Percent of total	Gross tons	Percent of total	Gross tons	Percent of total
Pacific Coast:									
Alaska	1								
Oregon	20	27,897	0.21	87,489	0.67	115,386	0.44	6,858	0.03
Washington	52								
California	120	182,714	1.37	364,506	2.79	547,220	2.07	101,227	.50
	193	210,611	1.58	451,995	3.46	662,606	2.51	108,085	.53
United States total	[1] 2,858	13,346,752	100.00	13,068,578	100.00	26,415,330	100.00	[2] 20,505,037	100.00

[1] Where 2 or more separate departments, such as blast-furnace department, open-hearth department, foundry department, etc., are at the same place and are operated by 1 establishment, each of them appears as a plant in the total.
[2] In addition, 115,426 tons were reported consumed in direct castings.

For further details on the consumption of iron and steel scrap and pig iron in 1935, the reader is referred to Report of Investigations 3329, Mineral Economic Series, entitled "Consumption of Ferrous Scrap and Pig Iron in 1935", which summarizes the results of the canvass inaugurated in 1935 by the Bureau of Mines in response to requests from industry. The canvass, now being continued on an annual basis, seeks to fill a long existent major gap in data on metalliferous raw materials.

IRON ORE

Production and shipments.—In 1936, 48,788,745 gross tons of iron ore were produced, an increase of 60 percent over 1935, and the largest output since 1930, but still 25 percent below the 1925–29 average. Of the 196 mines that contributed to the total in 1936, 11 produced more than a million tons each compared with 142 mines (including 5 in the million-ton class) in 1935. Eighteen States were active producers in 1936 compared with 16 in 1935. Shipments of iron ore, which increased 54 percent in 1936 over 1935, totaled 51,465,648 gross tons, the largest amount since 1930 but still 23 percent below the 1925–29 average. The majority of the iron ore mined in the United States is used in the manufacture of iron and steel, but 58,737 tons of ore produced in 1936 were used for other purposes, including the manufacture of cement (42,943 tons), paint (10,348 tons), flux at nonferrous smelters (223 tons), ferromagnesite (4,017 tons), hydrogen gas (461 tons), and gas purification (745 tons).

In the following tables the quantities of iron ore shown include ore that was beneficiated—that is, treated in any way—as well as ore that does not require treatment. Although included in the figures on production, the iron ore sold for the manufacture of paint (10,348

gross tons in 1936 valued at $53,037 ($5.13 a ton) compared with 4,795 tons in 1935 valued at $28,683 ($5.98 a ton)) is not included in the shipments from mines. The output of manganiferous ore that contained 5 percent or more manganese is also not included; 940,519 tons valued at $2,235,366 were shipped in 1936 compared with 524,184 tons valued at $1,322,611 in 1935. In Arkansas, one producer shipped 5 gross tons of loadstone, which is not included in the iron-ore statistics. Neither do the statistics include iron sinter recovered from the roasting of pyrites concentrate in Tennessee.

Iron ore mined in the United States, 1935–36, by States and varieties, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	Number of active mines	Hematite	Brown ore	Magnetite	Carbonate	Total
1935						
Alabama	25	3,028,294	249,241			3,277,535
California	2	18,489		245		18,734
Georgia	2		3,044			3,044
Michigan	35	5,205,531				5,205,531
Minnesota	56	19,374,623				19,374,623
Missouri	3	2,544				2,544
New Jersey	1			72,343		72,343
New York	3	(1)		[1] 297,266		297,266
North Carolina	1		54			54
Pennsylvania	2			978,951	687	979,638
Tennessee	1		14,219			14,219
Utah	3	160,761	200	249		161,210
Virginia	2	407	425			832
Washington	2	2,062		3,000		5,062
Wisconsin	3	788,483				788,483
Wyoming	1	339,134				339,134
	142	[1] 28,920,328	267,183	[1] 1,352,054	687	30,540,252
1936						
Alabama	46	3,739,221	440,746			4,179,967
California	3	[2] 31,395	(2)			31,395
Georgia	10		5,740			5,740
Michigan	39	9,177,629				9,177,629
Minnesota	68	31,634,064				31,634,064
Missouri	3	3,272				3,272
New Jersey	2			159,906		159,906
New Mexico	1			17,621		17,621
New York	4	(1)		[1] 777,643		777,643
North Carolina	1		57			57
Pennsylvania	2			1,131,682	533	1,132,215
Tennessee	2		27,617			27,617
Utah	4	39,489	268	114,434		154,191
Virginia	2	745	461			1,206
Washington	3	5,065		4,017		9,082
Wisconsin	3	969,522				969,522
Wyoming	1	507,278				507,278
(3)	2			340		340
	196	[1] [2] 46,107,680	[2] 474,889	[1] 2,205,643	533	48,788,745

[1] Some hematite included with magnetite.
[2] Some brown ore included with hematite.
[3] Bureau of Mines not at liberty to disclose identity.

Quantity and tenor of iron ore mined in the United States, 1935–36, by States and mining methods

State	1935				1936			
	Open pit (gross tons)	Underground (gross tons)	Total		Open pit (gross tons)	Underground (gross tons)	Total	
			Gross tons	Iron content (Nat.), percent			Gross tons	Iron content (Nat.), percent
Alabama	249,795	3,027,740	3,277,535	36.63	446,532	3,733,435	4,179,967	37.29
California	18,734		18,734	59.33	31,395		31,395	58.59
Georgia	95	2,949	3,044	48.62	4,673	1,067	5,740	36.97
Michigan	706,694	4,498,837	5,205,531	51.81	1,638,787	7,538,842	9,177,629	51.83
Minnesota	15,739,954	3,634,669	19,374,623	52.11	27,348,475	4,285,589	31,634,064	51.64
Missouri	1,944	600	2,544	51.53	2,347	925	3,272	60.51
New Jersey		72,343	72,343	59.69		159,906	159,906	63.90
New Mexico					17,621		17,621	58.00
New York	(1)	[1] 297,266	297,266	67.28	(1)	[1] 777,643	777,643	67.43
North Carolina	54		54	50.00	57		57	50.00
Pennsylvania	891,501	88,137	979,638	42.82	903,652	228,563	1,132,215	42.74
Tennessee	14,219		14,219	48.00	27,617		27,617	46.81
Utah	161,010	200	161,210	52.30	153,923	268	154,191	56.04
Virginia	832		832	51.32	1,206		1,206	51.82
Washington	3,000	2,062	5,062	55.00	4,017	5,065	9,082	45.64
Wisconsin		788,483	788,483	53.54		969,522	969,522	53.46
Wyoming	139,016	200,118	339,134	51.82	222,602	284,676	507,278	52.70
(2)					340		340	64.41
	[1] 17,926,848	[1] 12,613,404	30,540,252	50.30	[1] 30,803,244	[1] 17,985,501	48,788,745	50.59

[1] Some open pit included with underground.
[2] Bureau of Mines not at liberty to disclose identity.

Iron ore mined in the United States, by mining districts and varieties, 1935–36, gross tons

[Exclusive of ore containing 5 percent or more manganese]

District	Hematite	Brown ore	Magnetite	Carbonate	Total
1935					
Lake Superior [1]	25,368,365				25,368,365
Birmingham	3,009,740	172,582			3,182,322
Chattanooga	18,554	19,290			37,844
Adirondack			[2] 297,266		[2] 297,266
Northern New Jersey and southeastern New York			72,343		72,343
Other districts	[2] 523,669	75,311	982,445	687	[2] 1,582,112
	[2] 28,920,328	267,183	[2] 1,352,054	687	30,540,252
1936					
Lake Superior [1]	41,780,889				41,780,889
Birmingham	3,726,929	280,938			4,007,867
Chattanooga	12,292	47,028			59,320
Adirondack			[2] 777,643		[2] 777,643
Northern New Jersey and southeastern New York			159,906		159,906
Other districts	[2,3] 587,570	[3] 146,923	1,268,094	533	[2] 2,003,120
	[2,3] 46,107,680	[3] 474,889	[2] 2,205,643	533	48,788,745

[1] Includes only those mines in Wisconsin that are in the true Lake Superior district.
[2] Some hematite from "Other districts" included with magnetite from Adirondack district.
[3] Some brown ore included with hematite.

Iron ore shipped from mines in the United States, 1935-36, by States

[Exclusive of ore containing 5 percent or more manganese and ore sold for paint]

State	1935 Gross tons	1935 Value	1936 Gross tons	1936 Value
Alabama	3,559,934	$5,826,711	4,259,804	$6,838,016
California	18,734	(1)	31,045	(1)
Georgia	2,949	7,685	5,740	11,408
Idaho	41	(1)		
Michigan	7,235,698	20,788,153	10,491,270	30,721,075
Minnesota	20,035,653	50,260,668	32,938,883	83,523,720
Missouri	2,069	8,764	2,933	16,566
New Jersey	82,714	346,285	194,295	(1)
New Mexico			17,550	(1)
New York	309,628	1,184,776	801,236	(1)
North Carolina	54	(1)	57	(1)
Pennsylvania	936,421	1,872,842	1,104,454	2,208,908
Tennessee	14,219	29,909	27,617	73,720
Utah	161,010	(1)	153,923	375,475
Virginia	942	3,015	1,206	5,796
Washington	5,062	(1)	9,082	36,361
Wisconsin	722,224	1,949,568	918,935	2,568,129
Wyoming	339,134	(1)	507,278	(1)
(2)			340	(1)
Undistributed		[3] 756 185		[3] 5,361,420
	33,426,486	83,034,561	51,465,648	131,740,594

[1] Included under "Undistributed."
[2] Bureau of Mines not at liberty to disclose identity.
[3] This figure includes value for States entered as "(1)" above.

Principal iron-ore mines.—The importance of large mining units in the iron-mining industry is shown by the fact that in 1936 44 mines yielding more than 300,000 tons each produced nearly 80 percent of the entire output. Eleven mines—nine in Minnesota, one in Pennsylvania, and one in Alabama—produced more than a million tons each. Of the 44 principal producing mines, 18 were open pits, 21 were operated by underground methods alone, and 5 were combination. Hematite was produced by 42 of the 44 principal mines; the other 2 produced magnetite.

Iron-ore mines of the United States (arranged in order of rank) that produced more than 300,000 gross tons each in 1936

[All mines produced hematite except Cornwall and Witherbee Sherman group, which produced magnetite]

Name of mine	State	Nearest town	District	Mining method	Gross tons
Hull-Rust-Burt-Sellers group.	Minnesota	Hibbing	Mesabi	Open pit	6,628,952
Mahoning	do	do	do	do	2,521,824
Hill Annex	do	Calumet	do	do	2,174,422
Red Mountain group	Alabama	Bessemer	Birmingham	Underground	1,897,103
Minnewas	Minnesota	Virginia	Mesabi	Open pit	1,652,952
Adams-Spruce group	do	Eveleth	do	Combination	1,509,883
Cornwall	Pennsylvania	Miners Village	Cornwall	do	1,131,682
Morris	Minnesota	Hibbing	Mesabi	do	1,126,577
Missabe Mountain	do	Virginia	do	Open pit	1,067,067
Hartley-Burt	do	Chisholm	do	do	1,018,667
Canisteo	do	Coleraine	do	do	1,009,880
Morrison	do	do	do	do	993,293
Mesabi Chief	do	Nashwauk	do	do	876,007
Woodward No. 3	Alabama	Bessemer	Birmingham	Underground	807,185
Montreal	Wisconsin	Montreal	Gogebic	do	802,536
Biwabik	Minnesota	Biwabik	Mesabi	Open pit	676,875
Grant	do	Buhl	do	do	646,891
Godfrey	do	Chisholm	do	Underground	612,379
Plymouth	Michigan	Wakefield	Gogebic	Open pit	606,900
Maas	do	Negaunee	Marquette	Underground	548,473
Sloss Nos. 1 and 2	Alabama	Bessemer	Birmingham	do	546,115
Pioneer	Minnesota	Ely	Vermilion	do	541,033
Scranton	do	Hibbing	Mesabi	Open pit	530,002
Negaunee	Michigan	Negaunee	Marquette	Underground	512,612
Witherbee Sherman group.	New York	Mineville	Mineville	do	510,209
Bennett	Minnesota	Keewatin	Mesabi	Open pit	507,542

Iron-ore mines of the United States (arranged in order of rank) that produced more than 300,000 gross tons each in 1936—Continued

[All mines produced hematite except Cornwall and Witherbee Sherman group, which produced magnetite]

Name of mine	State	Nearest town	District	Mining method	Gross tons
Sunrise	Wyoming	Sunrise	Hartville	Combination	507, 278
Susquehanna	Minnesota	Hibbing	Mesabi	Open pit	506, 810
Raimund Nos. 1 and 2	Alabama	Bessemer	Birmingham	Underground	476, 526
Cliffs Shaft	Michigan	Ishpeming	Marquette	do	474, 925
Webb	Minnesota	Hibbing	Mesabi	Combination	474, 048
Alexandria	do	do	do	Underground	452, 315
Arcturus	do	Marble	do	Open pit	416, 614
Ironton	Michigan	Bessemer	Gogebic	Underground	412, 760
Blueberry	do	Ishpeming	Marquette	do	406, 709
Newport	do	Ironwood	Gogebic	do	397, 850
Eureka	do	Ramsay	do	do	378, 391
Davis - Geneva - West Davis.	do	Ironwood	do	do	366, 938
Lloyd	do	Ishpeming	Marquette	do	364, 326
Sunday Lake	do	Wakefield	Gogebic	do	360, 233
Morris	do	Ishpeming	Marquette	do	347, 397
Wacootah	Minnesota	Mountain Iron	Mesabi	Open pit	338, 617
Halobe	do	Cooley	do	do	327, 610
Athens	Michigan	Negaunee	Marquette	Underground	310, 888
Total (44 mines)					38, 777, 296
Output of 19 mines producing between 200,000 and 300,000 tons each					4, 582, 817
Output of 23 mines producing between 100,000 and 200,000 tons each					3, 469, 701
Output of 16 mines producing between 50,000 and 100,000 tons each					1, 175, 820
Output of 94 mines producing less than 50,000 tons each					783, 111
Grand total of United States (196 mines)					48. 788. 745

Beneficiated iron ore.—Beneficiation of iron ore was reported at 45 mines in 6 States in 1936 and at 39 mines in 6 States in 1935. At many mines the ore is crushed and screened to improve its structure; ore so improved, however, is not included in the statistics of beneficiated ore. Some iron ore is recovered in the form of dust from blast furnaces; ore so recovered, however, has been included originally in the statistics of shipments from mines.

Beneficiated ore shipped from domestic mines comprised 19 percent of total shipments and amounted to 9,658,699 gross tons valued at $25,937,597 in 1936, compared with 6,066,601 tons valued at $15,174,259 in 1935.

The concentratability of the important iron ores of the United States has been discussed by Cooke.[2]

Beneficiated iron ore shipped from mines in the United States, 1935–36

[Exclusive of ore containing 5 percent or more manganese and of ore sold for paint]

State	Variety	1935		1936	
		Gross tons	Value	Gross tons	Value
Alabama	Brown ore	226, 215	$514, 099	380, 544	$877, 894
Minnesota	Hematite	4, 874, 293	12, 046, 503	7, 510, 837	19, 062, 992
New Jersey	Magnetite	80, 302	344, 259	192, 935	(1)
New York	do	309, 628	1, 184, 776	801, 236	(1)
Pennsylvania	do	561, 944	1, 054, 713	745, 530	1, 365, 280
Tennessee	Brown ore	14, 219	29, 909	27, 617	73, 720
Undistributed					[2] 4, 557, 711
		6, 066, 601	15, 174, 259	9, 658, 699	25, 937, 597

1 Included under "Undistributed."
2 This figure includes value for States entered as (1) above.

2 Cooke, S. R. B., Miscroscopic Structure and Concentratability of the Important Iron Ores of the United States: Bull. 391, Bureau of Mines, 1936, pp. 1-121.

The quantity of crude ore beneficiated in the Lake Superior district in 1936 totaled 11,101,716 gross tons and the beneficiated ore recovered 6,822,278 tons—a ratio of 1.627 to 1. In 1935 the crude ore treated totaled 8,567,752 tons and the beneficiated ore recovered therefrom 4,884,192 tons—a ratio of 1.754 to 1. Most of the concentration in this district is done by washing, but a few plants are equipped with jigs. In recent years there has been developed on the Mesabi range a process for roasting ore to the magnetic state and concentrating on magnetic separators. The process, which is applicable to ores that cannot be concentrated either by washing or jigging, has been described by Davis.[3]

The following table shows that beneficiated ore is becoming a larger part of the total. Corresponding statistics for 1914 (the first year for which they were gathered) to 1927 are given in Mineral Resources for 1930. The figure for 1932 shows that in years of very low demand the richer ores are selected for mining and shipment.

Iron ore shipped from mines in the United States, 1927–31 (average) and 1932–36, in gross tons, and percentage of beneficiated ore compared to the total shipped

[Exclusive of ore containing 5 percent or more manganese and of ore sold for paint]

Year	Beneficiated	Total	Percentage of beneficiated to total	Year	Beneficiated	Total	Percentage of beneficiated to total
1927–31 [1]	7,962,140	56,797,057	14.0	1934	4,145,590	25,792,606	16.1
1932	407,486	5,331,201	7.6	1935	6,066,601	33,426,486	18.1
1933	3,555,892	24,624,285	14.4	1936	9,658,699	51,465,648	18.8

[1] Average.

Average value of ore.—The average value per gross ton of iron ore at the mines was $2.56 in 1936 compared with $2.48 in 1935.

The table that follows gives the average value at the mines of the different classes of iron ore in 1935–36 for each of the producing States or groups of States, except where there are less than three shippers of a certain variety of ore in a State and permission was not given to publish the value. These data are taken directly from statements of producers and probably represent the commercial selling prices only approximately, as not all reports are comparable. Some evidently include mining costs only; others contain, in addition, the cost of selling and insuring the ore; others include an allowance for sinking fund; and still others comprise only costs charged against blast furnaces. None of the reports, however, is supposed to include freight charges.

[3] Davis, E. W., First Magnetic Roasting Plant in the Lake Superior Region: Am. Inst. Min. and Met. Eng. Tech. Pub. 731, 1937, pp. 1–19.

Average value per gross ton of iron ore at mines in the United States, 1935–36

[Exclusive of ore containing 5 percent or more manganese and of ore sold for paint]

State	Hematite		Brown ore		Magnetite	
	1935	1936	1935	1936	1935	1936
Alabama	$1.59	$1.52	$2.28	$2.31		
Georgia			2.61	1.99		
Michigan	2.87	2.93				
Minnesota	2.51	2.54				
Missouri	4.14	5.65	(1)			
New Jersey			(1)	(1)	$4.29	(1)
New York					3.83	(1)
Pennsylvania					2.00	$2.00
Tennessee			2.10	2.67		
Wisconsin	2.70	2.79				
Other States [2]	1.41	1.44	2.11	4.31	6.86	2.76
	2.48	2.53	2.26	2.32	2.58	3.20

[1] Less than 3 producers; permission to publish not given, therefore value may not be shown.
[2] 1935: California, Idaho, North Carolina, Utah, Virginia, Washington, and Wyoming; 1936: California, New Mexico, North Carolina, Utah, Virginia, Washington, and Wyoming.

Iron ore consumed.—The production of 30,254,022 gross tons of pig iron in 1936 required 51,835,257 tons of iron and manganiferous iron ores, 3,521,544 tons of mill cinder and roll scale, and 903,310 tons of purchased scrap, an average of 1.860 tons of metalliferous materials per ton of iron made. In addition, 1,183,000 tons of home scrap and 1,340,600 tons of flue dust were consumed in 1936.

The greater part of the iron ore used in Alabama furnaces in 1936 was hematite, chiefly from mines in Jefferson County, but some came from Etowah and St. Clair Counties. Considerable brown ore, iron sinter, imported iron ore and manganese ores, and small quantities of ferruginous manganese and manganiferous iron ores were used. The brown ore was chiefly from mines in the Birmingham and Russellville districts, Alabama; the iron sinter was from Tennessee; and the ferruginous manganese ores and manganiferous iron ores came from Alabama, Arkansas, Georgia, and Tennessee. Imported manganese-bearing ores came from Cuba. In 1936 Alabama furnaces consumed an average of 2.312 tons of ore in making 1 ton of pig iron, the highest average for any State.

During 1936, in addition to foreign ores from Australia, Cuba, U. S. S. R. (Russia), and Chile, Maryland furnaces consumed considerable domestic ore. These furnaces used an average of 1.513 tons of ore in making 1 ton of pig iron; however, they used proportionately more cinder, scale, and scrap than furnaces in any other State except Kentucky.

The blast furnaces in Illinois, Indiana, Kentucky, Michigan, Minnesota, Ohio, and West Virginia operated on Lake Superior iron ore and manganiferous iron ore exclusively.

In New York the furnaces in the Buffalo district employed ore chiefly from the Lake Superior district, the furnace at Standish magnetite from the Chateaugay mine at Lyon Mountain, N. Y., and the furnace at Troy chiefly magnetite from Mineville, N. Y.

Virtually all of the ore consumed in furnaces in western Pennsylvania came from the Lake Superior district. Those in the eastern part of the State used some lake ores; magnetite ores from Pennsylvania, New Jersey, and New York; and considerable quantities of ore from Africa, Asia, Australia, Brazil, Chile, Cuba, and Sweden.

The blast furnaces at Pueblo, Colo., employed hematite from the Sunrise mine in Wyoming, magnetite from New Mexico, rhodochrosite from Butte, Mont., and manganese-bearing ores from Colorado, New Mexico, and Utah.

The Provo (Utah) furnace consumed hematite from the Desert Mound mine near Iron Springs, Utah, semialtered magnetite from the Iron Mountain mine near Cedar City, and manganese tailings from Philipsburg, Mont.

The furnace in Tennessee used brown ore and iron sinter from Tennessee.

Iron ore and other metallic materials consumed and pig iron produced in 1936, by States, in gross tons

State	Metalliferous materials consumed: Iron and manganiferous iron ores: Domestic	Metalliferous materials consumed: Iron and manganiferous iron ores: Foreign	Metalliferous materials consumed: Cinder, scale, and purchased scrap	Metalliferous materials consumed: Total	Pig iron produced, exclusive of ferroalloys	Materials consumed per ton of iron made: Ores	Materials consumed per ton of iron made: Cinder, scale, and purchased scrap	Materials consumed per ton of iron made: Total
Alabama	4,610,484	9,334	79,613	4,699,431	1,998,212	2.312	0.040	2.352
Illinois	5,150,443		357,488	5,507,931	2,917,016	1.766	.122	1.888
Indiana	5,680,209		446,294	6,126,503	3,230,537	1.758	.138	1.896
Kentucky	269,184		82,218	351,402	225,214	1.195	.365	1.560
Maryland	367,860	1,471,819	236,848	2,076,527	1,216,065	1.513	.195	1.708
Michigan	1,471,601		142,261	1,613,862	937,762	1.569	.152	1.721
Minnesota	205,533		4,956	210,489	106,768	1.925	.046	1.971
New York	3,715,316	2,062	152,166	3,869,544	2,190,478	1.697	.070	1.767
Ohio	11,904,299		1,156,835	13,061,134	7,206,762	1.652	.160	1.812
Pennsylvania	14,774,176	299,255	1,649,967	16,723,398	9,105,058	1.656	.181	1.837
West Virginia	1,063,355		84,976	1,148,331	641,736	1.657	.132	1.789
Undistributed [1]	747,074	93,253	31,232	871,559	478,414	1.757	.065	1.822
	49,959,534	1,875,723	4,424,854	56,260,111	30,254,022	1.714	.146	1.860

[1] Includes Colorado, Iowa, Massachusetts, Tennessee, and Utah.

Foreign iron and manganiferous iron ore consumed in the manufacture of pig iron in the United States, 1935–36, by sources of ore, in gross tons

Source of ore	1935	1936	Source of ore	1935	1936
Africa	13,640	39,622	Newfoundland		24,184
Asia		307	Spain	9,638	
Australia	66,879	104,999	Sweden	20,547	4,524
Brazil	97	6,082	U. S. S. R. (Russia)	125,646	74,445
Canada	1,830		Undistributed		92
Chile	864,060	1,297,971			
Cuba	268,371	323,497		1,370,708	1,875,723

Stocks of ore at mines.—Stocks of iron ore at the mines at the end of 1936, according to reports of the producers, were the lowest since 1907. During 1936 stocks decreased 30 percent.

Stocks of iron ore at mines, Dec. 31, 1935–36, by States, in gross tons

State	1935	1936	State	1935	1936
Alabama	128,311	48,244	New York	85,512	55,299
Georgia	95	95	North Carolina	200	200
Iowa	12,165	12,165	Pennsylvania	43,135	70,392
Michigan	4,854,756	3,691,445	Virginia	3,363	3,363
Minnesota	2,204,206	1,120,312	Wisconsin	341,670	361,597
Missouri	5,072	4,574			
New Jersey	108,240	73,851		7,786,725	5,441,608
New Mexico		71			

Foreign trade in iron ore.—Imports of iron ore amounted to 2,232,229 gross tons in 1936, an increase of 50 percent over 1935. Chile continued to be the chief source of imports, furnishing 57 percent of the total, while Cuba supplied 20 and Sweden 7 percent.

Iron ore imported into the United States, 1934–36, by countries

Country	1934		1935		1936	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Africa:						
Algeria and Tunisia [1]	49,850	$179,929	13,900	$33,941	12,293	$38,602
Morocco	6,100	25,900				
Australia	49,689	89,568	160,016	337,464	72,904	158,327
Brazil					6,102	22,209
Canada	11,126	56,486	20,453	111,096	83,911	407,230
Chile	938,376	1,914,069	788,725	1,460,073	1,264,130	2,291,010
Cuba	154,500	363,674	221,010	528,518	444,500	1,055,908
Germany	20	614	149	2,602	11	477
Iran			2,950	46,664	2	84
Mexico	1,618	3,584	2,105	5,136	3,687	8,933
Netherlands	169	3,374				
Newfoundland and Labrador					11,300	34,352
Norway	68,249	240,738	110,027	394,596	158,344	557,917
Philippine Islands					377	2,936
Spain	1,159	13,676	946	10,130	198	2,655
Sweden	40,535	202,079	57,753	289,164	166,150	678,451
U. S. S. R. (Russia)	100,605	177,374	113,840	249,303	7,750	11,238
United Kingdom	5,525	36,439	561	13,751	570	9,868
	1,427,521	3,307,504	1,492,435	3,482,438	2,232,229	5,280,197

[1] 1936; Algeria only.

Exports of iron ore from the United States totaled 645,284 gross tons valued at $1,962,527 ($3.04 a ton) in 1936, compared with 660,553 tons valued at $1,913,463 ($2.90 a ton) in 1935. Of the 1936 total, 636,524 tons valued at $1,911,866 went to Canada, 5,602 valued at $16,104 went to the United Kingdom, 3,063 valued at $33,085 went to Japan, and 95 tons valued at $1,472 went to Mexico.

Iron-ore mining in Cuba.—Shipments of iron ore from Cuba to the United States doubled in 1936 over 1935. The 1936 total of 449,611 gross tons included 254,354 tons of hematite carrying (dried) 56.69 percent iron and 124,215 tons of siliceous ore carrying (dried) 32.06 percent iron from the Daiquiri-Juragua mines on the southern coast, and 71,042 tons of nodulized brown ore carrying (dried) 54.92 percent iron from the Mayari mines near the northern coast.

The total stock of ore reported on hand was 386,828 gross tons at the end of the year compared with 571,987 tons at the end of 1935.

The following table shows the shipments of iron ore from Cuba since the mines were opened in 1884. The statistics of shipments of Cuban iron ore are collected by the Bureau of Mines.

Iron ore shipped from mines in the Province of Oriente, Cuba, 1884–1936, in gross tons

Year	Juragua (hematite and magnetite), Daiquiri (hematite and a little magnetite)	Sigua (hematite)	Mayari (brown ore)	Guamá (hematite)	El Cuero (hematite)	Total
1884–1934	[1] 20,775,919	20,438	3,693,326	41,241	903,103	25,434,027
1935	177,128		47,672			224,800
1936	378,569		71,042			449,611
	21,331,616	20,438	3,812,040	41,241	903,103	26,108,438

[1] Of this quantity, 5,932 tons were sent to Pictou, Nova Scotia, and 64,228 tons to ports outside of the United States.

REVIEW OF LAKE SUPERIOR DISTRICT

Production.—The total quantity of iron ore mined in the Lake Superior district (the principal producing district) was 41,780,889 tons in 1936, an increase of 65 percent over 1935. Output from this district, which produced 86 percent of the domestic total in 1936, comes from several ranges; of these the Mesabi is the largest producer, contributing 72 percent of the district total and 62 percent of the United States total in 1936. The output, by ranges, is shown in the following table. After 1905, the figures do not include manganiferous iron ore containing 5 percent or more manganese.

Iron ore mined in the Lake Superior district, 1854–1936, by ranges, in gross tons

[Exclusive after 1905 of ore containing 5 percent or more manganese]

Year	Marquette	Menominee	Gogebic	Vermilion	Mesabi	Cuyuna	Total
1854–1934	182,020,768	176,899,254	194,795,363	61,391,930	935,663,924	23,955,657	1,574,726,896
1935	2,865,292	730,456	2,397,994	846,617	18,323,695	204,311	25,368,365
1936	4,423,420	1,642,548	4,080,857	1,049,722	30,205,378	378,964	41,780,889
	189,309,480	179,272,258	201,274,214	63,288,269	984,192,997	24,538,932	1,641,876,150

Shipments.—The shipments of ore from the Lake Superior district amounted to 45,250,767 gross tons (44,352,214 tons of iron ore and 898,553 tons of manganese-bearing ores containing 5 percent or more of manganese) in 1936 compared with 28,504,821 tons (27,995,498 tons of iron ore and 509,323 tons of manganese-bearing ores) in 1935. The iron-ore statistics given above include 3,126 tons of paint ore in 1936 and 1,923 tons of paint ore in 1935.

Iron-ore analyses.—The iron content of the iron ore and manganiferous iron ore shipped from the Lake Superior district in 1936 averaged 51.45 percent (natural) compared with 51.44 percent in 1935 and 51.49 percent in 1934.

The following table, compiled by the Lake Superior Iron Ore Association, summarizes the average analyses of the total tonnages of all grades of ore shipped and shows the remarkable uniformity maintained during the past 5 years. This uniformity does not mean, of course, that the average grade of the available Lake Superior ore is not declining. The grade of shipments has been maintained partly by beneficiation and partly by mixing ores from different deposits.

Average analyses of total tonnages of all grades of iron ore from all ranges of Lake Superior district, 1932–36

Year	Gross tons	Iron (natural)	Phosphorus	Silica	Manganese	Moisture
		Percent	*Percent*	*Percent*	*Percent*	*Percent*
1932	3,552,575	52.16	0.099	9.05	0.68	9.92
1933	21,455,174	51.85	.090	8.96	.71	10.47
1934	21,841,382	51.49	.087	8.93	.76	10.66
1935	28,214,056	51.44	.093	8.93	.79	10.75
1936	44,745,754	51.45	.091	8.62	.81	10.92

Stocks of ore at Lake Erie ports.—At the close of navigation in 1936, according to the Lake Superior Iron Ore Association, 4,918,348 gross tons were in stock at Lake Erie ports compared with 5,313,265 tons

on the corresponding date in 1935. At the opening of navigation in May 1937, only 2,336,653 tons were in stock at these ports (the lowest since 1907), indicating a withdrawal of 2,581,695 tons during the winter 1936–37.

Prices of Lake Superior ore.—The unit prices established April 1, 1936, for the four standard grades of Lake Superior ore are the same as those for 1929–35, as follows: Old-range Bessemer, 9.32 cents; Mesabi Bessemer, 9.029 cents; Old-range non-Bessemer, 9.029 cents; and Mesabi non-Bessemer, 8.738 cents. The prices per gross ton that correspond to these prices are, respectively, \$4.80, \$4.65, \$4.65, and \$4.50. The base of Bessemer ore, Old-range and Mesabi, for 1925–36 is a metallic content of 51.5 percent (natural) instead of 55 percent, as for 1924 and many earlier years. The base of the non-Bessemer ore, Old-range and Mesabi remains as heretofore at 51.5 percent (natural).

Iron-ore reserves.—Estimates of ore reserves for Minnesota, furnished by the Minnesota Tax Commission, and for Michigan, furnished by the Michigan Board of Tax Commissioners, shown in the following tables, cover developed and prospective ore in the ground and ore in stock piles. These estimates exhibit an increase over the previous year of 1,147,424 tons in Minnesota and a decrease of 4,391,304 tons in Michigan. Reserves in Wisconsin have been estimated at 6,000,000 tons.

Iron-ore reserves in Minnesota, May 1, 1932–36, in gross tons

Range	1932	1933	1934	1935	1936
Mesabi	1, 190, 295, 183	1, 205, 213, 398	1, 195, 271, 786	1, 178, 270, 779	1, 164, 802, 947
Vermilion	14, 237, 637	14, 007, 192	13, 243, 125	13, 656, 569	13, 074, 509
Cuyuna	69, 699, 960	70, 024, 921	47, 553, 536	47, 869, 112	63, 066, 428
	1, 274, 232, 780	1, 289, 245, 511	1, 256, 068, 447	1, 239, 796, 460	1, 240, 943, 884

Iron-ore reserves in Michigan, Jan. 1, 1933–37, in gross tons

Range	1933	1934	1935	1936	1937
Gogebic	50, 473, 546	48, 612, 579	47, 721, 016	45, 615, 323	42, 757, 025
Marquette	55, 894, 039	54, 564, 005	53, 513, 561	52, 461, 173	51, 339, 347
Menominee	58, 264, 532	60, 845, 357	60, 978, 904	60, 347, 752	59, 936, 572
	164, 632, 117	164, 021, 941	162, 213, 481	158, 424, 248	154, 032, 944

IRON ORE MINING BY STATES

Alabama.—In 1936, 4,179,967 gross tons of iron ore (3,739,221 tons of hematite and 440,746 tons of brown ore) were produced in Alabama, an increase of 28 percent over 1935. About 89 percent of the Alabama output in 1936 came from underground operations. The hematite, much of which contains enough lime to make it self-fluxing or nearly so, was produced chiefly at the Raimund Nos. 1 and 2, Red Mountain group, Sloss Nos. 1 and 2, and Woodward No. 3 mines, all underground operations in Jefferson County. Five (four open pit and one underground) other smaller operations in Etowah and St. Clair Counties contributed to the total for hematite ore. The iron content of the hematite produced in 1936 averaged (natural) 35.98 percent, the manganese content 0.16 percent, the phosphorus content 0.31 percent, and the lime content 16.35 percent. The Red Mountain group (1,897,103 tons) was the largest producing iron mine in Alabama and the fourth largest in the United States in 1936.

The brown ore mined in 1936, which averaged 48 percent iron (natural) and 0.66 percent manganese, was produced by a number of mines but chiefly from the Russellville mines in Franklin County, the Champion mines in Blount County, and the Reno mine in Tuscaloosa County.

California.—Production in California in 1936 of 31,395 gross tons came from three mines, two in San Bernardino County and one in Placer County. Virtually all of the San Bernardino ore, which was hematite containing (natural) 58.75 percent iron, was used in cement manufacture and the Placer County ore (brown ore) absorbed by the paint industry.

Georgia.—Production in Georgia in 1936, amounting to 5,740 gross tons, came from 10 operations, 6 in Bartow County and 4 in Polk County. The output, all brown ore, contained 28 to 51 percent iron and 0.3 to 5.0 percent manganese.

Michigan.—Output in Michigan increased 76 percent in 1936 over 1935 and totaled 9,177,629 gross tons. Eighty-two percent of the total came from underground mines in 1936; but the largest producer, the Plymouth mine, was an open-pit operation. The iron content (natural) of the ore mined in 1936 averaged 51.83 percent compared with 51.81 percent in 1935.

Increased production on the Michigan ranges in 1936 resulted in increased employment, and a scarcity of skilled underground miners necessitated the training of younger men.

Reserves in Michigan amounted to 154,032,944 gross tons at the end of 1936, a decrease of 4,391,304 tons from the previous year.

A report on the iron-ore mines of Michigan for 1936, published by the geological survey division of the Michigan Department of Conservation,[4] shows that the average number of men employed was 4,929 (4,172 in 1935), the average number of days worked 238 (196 in 1935), the average daily wage \$4.87 (\$4.62 in 1935), the average yearly earning \$1,160.18 (\$905.95 in 1935), and the average tons of ore mined per man per day 5.58 (5.40 in 1935).

The data in the following table on average per-ton costs of mining ore at underground mines and at siliceous open pits have been abstracted from statistics published in much greater detail by the Geological Survey Division of Michigan.

Average per-ton costs of mining iron ore at underground mines and at siliceous open pits in Michigan in 1936

Item	Underground				Siliceous open pits
	Gogebic	Marquette	Dickinson and Iron	Total	
Cost of mining	$1.4817	$1.3359	$1.4824	$1.4103	$0.3882
Deferred mining cost	.3048	.0379	.0501	.1192	.0550
Taxes	.2922	.1683	.1320	.1971	.0261
General overhead	.2228	.2015	.2527	.2187	.0796
Transportation	1.8384	1.4879	1.6715	1.6581	1.4924
Marketing	.0464	.0878	.0702	.0705	.0917
Royalty	.3871	.2636	.2648	.3053	.0842
Interest on borrowed money	.0014	.0036	.0028	.0102	.00002
Total ore cost	4.5748	3.5865	3.9265	3.9894	2.21722
Lake Erie value per ton	4.9442	4.8063	4.5034	4.7950	2.2208
Gross ore profit [1]	.3694	1.2198	.5769	.8056	.00358

[1] This figure does not represent true profit, as much ore is sold below the Lake Erie price.

[4] Pardee, F. G., and Eddy, G. E., General Statistics Covering Costs and Production of Michigan Iron Mines: Michigan Dept. of Conservation, Geol. Survey Div., Lansing, 1937.

Minnesota.—In 1936 production of iron ore in Minnesota, the principal producing State, increased 63 percent over 1935, to 31,634,064 gross tons, and was the largest since 1930. Output from open-pit mines increased 74 percent and thus supplied 86 percent of the Minnesota total compared with 81 percent in 1935. From this it appears that under pressure for increased production open pits respond more quickly than underground operations. Of the 11 mines producing more than 1 million tons each in 1936, 9 were in Minnesota; of these, 7 were open pits and 2 employed combination open-pit and underground operations. Of the 68 active mines in Minnesota in 1936 (56 in 1935), 46 (36 in 1935) yielded more than 100,000 tons each. The iron content (natural) of the ore mined in 1936 averaged 51.64 percent compared with 52.11 percent in 1935.

According to the annual report of the mine inspector of St. Louis County, an average of 4,694 men was employed in iron mines in St. Louis County during 1936 (4,079 in 1935), and the average daily wage was $5.32 ($5.20 in 1935) for 8 hours. In 1936, 1,683,664 cubic yards of overburden were removed compared with 1,586,978 cubic yards in 1935.

In Crow Wing County (Cuyuna range), according to the mine inspector's report, 563 men were employed in 1936 compared with 305 men in 1935. In 1936, 870,303 cubic yards of overburden were removed, compared with 539,628 yards in 1935.

Missouri.—Three mines produced 3,272 gross tons of iron ore in Missouri in 1936 compared with three mines and 2,544 tons in 1935. The ore, all hematite, was used by the iron and steel and paint industries.

New Jersey.—Output of iron ore in New Jersey more than doubled in 1936 over 1935 and totaled 159,906 gross tons. The ore, all magnetite and all produced from underground operations, came from two mines, the Scrub Oaks and the Richards, both near Dover, N. J. New Jersey ores are crushed and concentrated magnetically before shipment. Concentrates from the Scrub Oaks mine averaged (dried) 67.27 percent iron and 0.035 percent phosphorus, and the ore from the Richards mine contained (dried) 60.29 percent iron. The present status of iron mining in New Jersey has been described recently by Roche.[5]

New Mexico.—One operation in New Mexico produced 17,621 gross tons of magnetite carrying (natural) 58 percent iron in 1936.

New York.—The production of iron ore in New York, which increased 162 percent over 1935 and amounted to 777,643 gross tons, was chiefly magnetite from underground operations at the Harmony and Old Bed shafts in Essex County and the Chateaugay mine in Clinton County. Some hematite was mined for paint in Oneida and Wayne Counties. Shipments from New York in 1936 included 627,056 tons of sinter averaging 67.89 percent iron, 125,029 tons of lump ore averaging 61.52 percent iron, and 49,151 tons of concentrates averaging 68.50 percent iron.

North Carolina.—The Maltby mine in Cherokee County produced and shipped 57 tons of brown ore, the total for North Carolina in 1936.

Pennsylvania.—Pennsylvania, the most important source of magnetite in the United States, produced 1,132,215 gross tons of ore in 1936 compared with 979,638 tons in 1935. The production consisted chiefly

[5] Roche, H. M., The Iron Ores of New Jersey: Iron Age, vol. 139, no. 5, Feb. 4, pp. 74–80, and no. 7, Feb. 18, 1937, pp. 39–43.

of 1,131,682 tons of magnetite from the Cornwall mines in Lebanon County; it averaged 42.74 percent iron (natural). Some carbonate ore for use in paint was mined in Carbon County in 1936.

Tennessee.—The output and shipments from Tennessee in 1936, amounting to 27,617 gross tons of brown ore, came from two open-pit operations. The Van Leer mine in Lawrence County produced 5,456 tons of brown ore concentrates averaging (natural) 42 percent iron, and the Johnson mine in Hickman County produced 22,161 tons containing 48 percent iron (natural).

A considerable quantity of iron sinter is made annually from roasted pyrites concentrates in Ducktown Basin in Polk County, but this material is not included in the statistics of iron ore. In 1936 this sinter contained 66.44 percent iron and 0.006 percent phosphorus.

Utah.—The production of iron ore in Utah in 1936, which decreased 4 percent from 1935, amounted to 154,191 gross tons; of this, 39,489 tons were hematite and most of the remainder magnetite. The largest output came from the Iron Mountain mine in the Iron Springs district, a new mine opened in 1936. The ore, which is semialtered magnetite, contains (natural) 57.33 percent iron. A small part of the shipments from this mine went for flux at nonferrous smelters and for cement manufacture. The Desert Mound mine, also in the Iron Springs district, produced and shipped all the hematite in Utah in 1936; the ore averaged (natural) 52.3 percent iron. Some brown ore (268 tons) was shipped from the Tecoma mine in Box Elder County in 1936 for use in paint.

The following is an abstract of a paper prepared in 1936 by F. G. Wells of the United States Geological Survey on the origin of the iron ore in the Bull Valley and Iron Springs districts of Utah.

The iron-ore deposits of the Bull Valley and Iron Springs districts, Utah, consist of veins of magnetite and hematite in monzonite, and magnetite-hematite replacement bodies in limestone. Neither ores nor country rock show features characteristic of contact metamorphic deposits. The following explanation of the origin of the deposits is offered. During the intrusion of monzonite porphyry stocks, the hoods and overlying rock were fractured, causing a sudden release of pressure and liberating $FeCl_3$ and H_2O gas from the stocks, which were still at high temperature. These gases found ready egress to the surface along tension fissures without appreciably heating the country rock. They deposited magnetite and hematite in the fissures and replaced the contiguous fractured limestone. The period of gas emanation was brief, and the hydrothermal phase probably evolved during the later magmatic history never reached this area. The deposits were formed under a cover of less than 5,000 feet.

Virginia.—The production of iron ore in Virginia in 1936 amounted to 745 gross tons of hematite, containing (natural) 56.06 percent iron and 0.06 percent phosphorus, from the Chestnut Flat mine in Giles County, and 461 tons of brown ore, containing 45 percent iron, from the Oriskany mine in Botetourt County. The hematite was shipped for gas purification and the brown ore for use in hydrogen gas manufacture.

Washington.—Three mines, two yielding hematite and the other magnetite, produced 9,082 gross tons of iron ore in Washington in 1936. All of the magnetite came from the Big Iron mine in Stevens County; it contained 60.10 percent iron (natural) and was used in making ferromagnesite. The ore from Keystone mine in Washington County, containing 56.65 percent iron (natural), was used for cement. The other hematite ore, which contained (natural) 25.27 percent iron and 48.32 percent silica, was also used for cement.

Wisconsin.—The Montreal mine, an underground operation in Iron County, was the largest producer of iron ore in Wisconsin, contributing 802,536 gross tons of the 969,522 produced in Wisconsin in 1936. The ore, which is hematite, averaged (natural) 53.06 percent iron, 1.50 percent manganese, and 0.054 percent phosphorus. The Cary mine, also an underground operation in Iron County, was the other chief producer in 1936, furnishing 166,660 tons of hematite containing (natural) 55.39 percent iron, 0.39 percent manganese, and 0.046 percent phosphorus. In addition, 326 tons of hematite were produced and shipped for paint from the Iron Ridge mine in Dodge County. Shipments from Wisconsin mines totaled 918,935 tons in 1936.

Wyoming.—Output of iron ore from Wyoming in 1936 came from the Sunrise mine and comprised 507,278 gross tons of hematite containing (dried) 56.3 percent iron, 0.09 percent manganese, 0.064 percent phosphorus, and 11.1 percent silica. Production came from open-pit and underground operations.

Iron ore mined in the United States, 1935–36, by States and counties

[Exclusive of ore containing 5 percent or more manganese]

State and county	1935 Active mines	1935 Gross tons	1936 Active mines	1936 Gross tons
Alabama:				
Bibb and Tuscaloosa	3	49,741	9	137,055
Blount	2	102,204	2	108,254
Butler and Crenshaw	3	10,960	3	3,701
Calhoun	---	---	4	23,597
Cherokee	1	334	4	5,100
Chilton	1	310	3	15,303
Cleburne	---	---	1	948
Coosa	1	11,527	1	5,370
Etowah	1	18,000	2	6,594
Franklin	1	49,507	2	114,876
Jefferson	6	3,009,740	4	3,726,929
St. Clair	1	554	3	5,698
Shelby	1	20,327	2	20,326
Talladega	4	4,331	6	6,216
	25	3,277,535	46	4,179,967
California:				
Placer	---	---	1	31,395
San Bernardino	2	18,734	2	
	2	18,734	3	31,395
Georgia:				
Bartow	---	---	6	4,140
Polk	2	3,044	4	1,600
	2	3,044	10	5,740
Michigan:				
Dickinson	3	195,933	4	285,716
Gogebic	9	1,609,783	10	3,111,661
Iron	9	534,523	10	1,356,832
Marquette	14	2,865,292	15	4,423,420
	35	5,205,531	39	9,177,629
Minnesota:				
Crow Wing	3	204,311	4	378,964
Itasca	19	6,036,059	27	8,352,340
St. Louis	34	13,134,253	37	22,902,760
	56	19,374,623	68	31,634,064
Missouri:				
Dent	1	600	1	925
Franklin	1	1,500	1	2,050
Phelps	1	444	1	297
	3	2,544	3	3,272
New Jersey: Morris	1	72,343	2	159,906
New Mexico: Grant	---	---	1	17,621
New York:				
Essex	1	297,266	1	510,209
Clinton	1		1	267,434
Oneida	1		1	
Wayne	---	---	1	
	3	297,266	4	777,643
North Carolina: Cherokee	1	54	1	57
Pennsylvania:				
Carbon	1	687	1	533
Lebanon	1	978,951	1	1,131,682
	2	979,638	2	1,132,215
Tennessee:				
Hickman	1	14,219	1	22,161
Lawrence	---	---	1	5,456
	1	14,219	2	27,617
Utah:				
Box Elder	1	200	1	268
Iron	2	161,010	3	153,923
	3	161,210	4	154,191
Virginia:				
Botetourt	1	425	1	461
Giles	1	407	1	745
	2	832	2	1,206
Washington:				
Stevens	2	5,062	2	7,534
Washington	---	---	1	1,548
	2	5,062	3	9,082
Wisconsin:				
Dodge	1	272	1	326
Iron	2	788,211	2	969,196
	3	788,483	3	969,522
Wyoming: Platte	1	339,134	1	507,278
(1)	---	---	2	340
	142	30,540,252	196	48,788,745

1 Bureau of Mines not at liberty to disclose identity.

MEN EMPLOYED AND OUTPUT PER MAN AT IRON-ORE MINES

Accelerated activity at blast furnaces and steel plants in 1936, which increased the demand for iron ores, undoubtedly increased employment at iron mines, also. Statistics of employment in 1936 are not available as yet, but some of the districts reported a shortage of experienced underground miners due to curtailment of operations during the depression, when the men either left the area or found employment in other industries and were reluctant to return to mining. To remedy this condition some of the companies placed younger men with capable miners, thereby training new help and continuing production under safe conditions. Wage increases were common during 1936, and in many districts vacations with pay were inaugurated. The extent of the vacation was based, in part, on the length of service.

During 1935, the last year for which statistics are available, greater demand for iron ore resulted in increasing labor at iron mines, but the

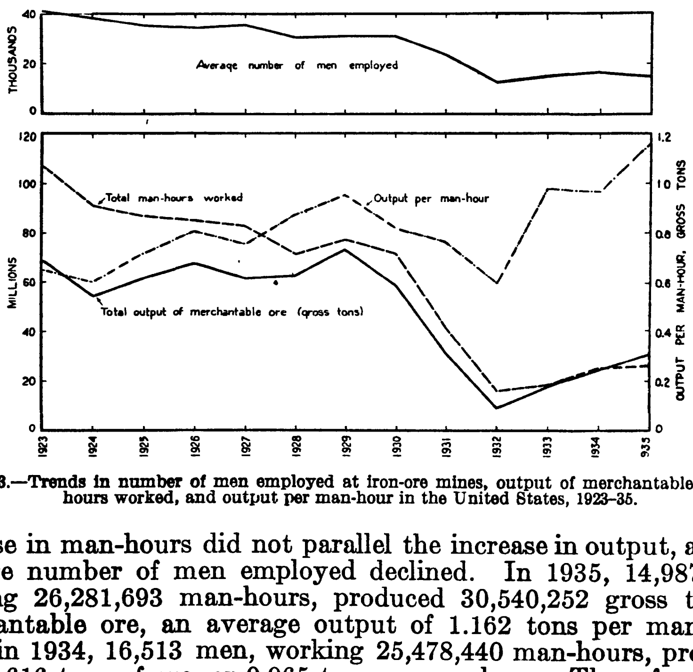


FIGURE 33.—Trends in number of men employed at iron-ore mines, output of merchantable ore, man-hours worked, and output per man-hour in the United States, 1923–35.

increase in man-hours did not parallel the increase in output, and the average number of men employed declined. In 1935, 14,987 men, working 26,281,693 man-hours, produced 30,540,252 gross tons of merchantable ore, an average output of 1.162 tons per man-hour; while in 1934, 16,513 men, working 25,478,440 man-hours, produced 24,587,616 tons of ore, or 0.965 ton per man-hour. Thus, from 1934 to 1935 the total man-hours worked increased 3 percent, while the total merchantable ore increased 24 percent and the average output per man-hour increased 20 percent. The output per man-hour in 1935 exceeded that for any year since records have been compiled and undoubtedly was greater than in any other year. This relatively small labor requirement in 1935 was the result of several factors, including increased output from open-pit mines, decrease in stripping per ton of open-pit ore, nearer capacity production of operating units, and increase in number of days worked per year. Conversely, the relative amount of beneficiated ore increased in 1935 to nearly 19.9 percent of the total output, but apparently this was overshadowed by the items listed above.

The number of man-hours of labor increased in 1935 over 1934 in all districts except the Lake Superior region, the principal producing area. In this district the output of merchantable ore per man-hour increased 22.5 percent, from 1.100 tons in 1934 to 1.348 tons in 1935. With an increase in production of 4,337,618 tons (21 percent), the average number of men employed, the total man-shifts, and the total man-hours declined. The average number of days worked increased, however. A large part of the output of this district comes from Minnesota, where open pits furnished 81 percent of the ore in 1935. Output per man-hour in Minnesota increased 31 percent, from 1.428 tons in 1934 to 1.877 tons in 1935. Although, as was pointed out in Minerals Yearbook, 1934 (p. 322), the improved performance in mining iron ore has been closely related to advances in mechanization, improved mining methods, operation of larger units, and more efficient management of mines, the gain in 1933, 1934, and 1935 compared with the 10 years 1923–32 was due chiefly to the expansion of open-pit operations in Minnesota. For example, while about 75 percent of the merchantable ore produced in Minnesota from 1923 to 1932 came from open-pit mines, 82 percent was so produced in 1933–35. The significance of this shift can be appreciated when it is recalled that Minnesota contributed more than 60 percent of the total merchantable ore produced during the period 1923–35, and that during that period the output of men at open-pit operations averaged 1.848 tons per man-hour compared with only 0.684 ton per man-hour for workers at underground mines.

The greater output per man-hour in recent years was also due in part to the stripping of proportionately less overburden in Minnesota in 1933, 1934, and 1935 in preparation for future mining than in the period 1923–32. In 1933–35, about one-fourth cubic yard of overburden was removed for each ton of merchantable ore mined in Itasca and St. Louis Counties, Minn., whereas during the 10 years 1923–32 about one-half cubic yard of overburden was removed for each ton of merchantable ore mined. Any material shift in the labor force to the direct mining of ore at the expense of that used for stripping will result in a much lower man-hour cost of mining for any year. This is strikingly illustrated in figure 34, which shows that in 1926, 1933, 1934, and 1935, when only about one-fourth cubic yard of overburden was removed to each ton of merchantable ore mined at both open-pit and underground mines, the average output per worker increased substantially, whereas during the other years, when one-third to four-fifths cubic yard of overburden was removed to each ton of ore mined, the output of the worker decreased.

Another factor that affects the output per man-hour is the tendency to mine leaner ore. Proportionately more lean ore requiring beneficiation has been mined in Minnesota in recent years than during 1923–32. In 1935, for instance, beneficiated ore represented 25 percent of the total merchantable ore produced in Minnesota compared with an average of 20.72 percent for 1933–34 and with an average of only 16.07 percent during the period 1923–32.

The bulk of the ore in the Southeastern district, the second largest producing region, is obtained from underground operations. Output of merchantable ore per man-hour in this area increased from 0.503 ton per man-hour in 1934 to 0.588 ton per man-hour in 1935. The largest and most consistent producing mines in the Southeastern district are in Jefferson County, Ala., where 2,532 men working 4,449,974

man-hours in 1935 produced 3,009,740 tons of merchantable ore, equivalent to an average output per man-hour of 0.676 ton; 2,444 men working 3,726,143 man-hours in 1934 produced 2,049,915 tons of merchantable ore, equivalent to an average output per man-hour of 0.550 ton. All ore produced in Jefferson County comes from underground operations. In comparing the man-hour cost of mining ore in Jefferson County, Ala., with that at underground mines in the Lake

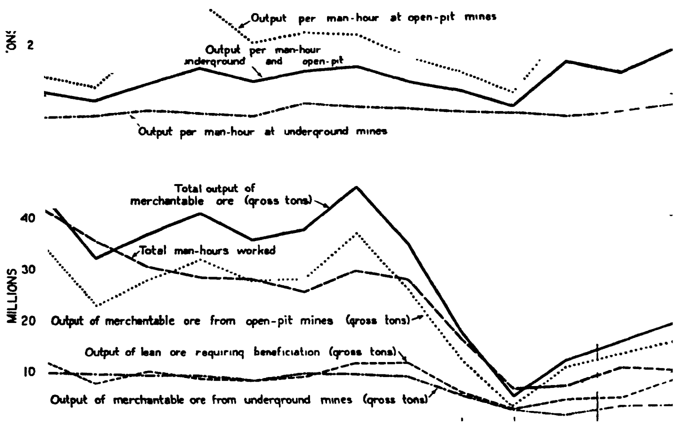


FIGURE 34.—Trends in output of merchantable iron ore per man-hour at open-pit and underground mines in Minnesota compared with production of merchantable and lean ore, and total man-hours worked, 1923–35.

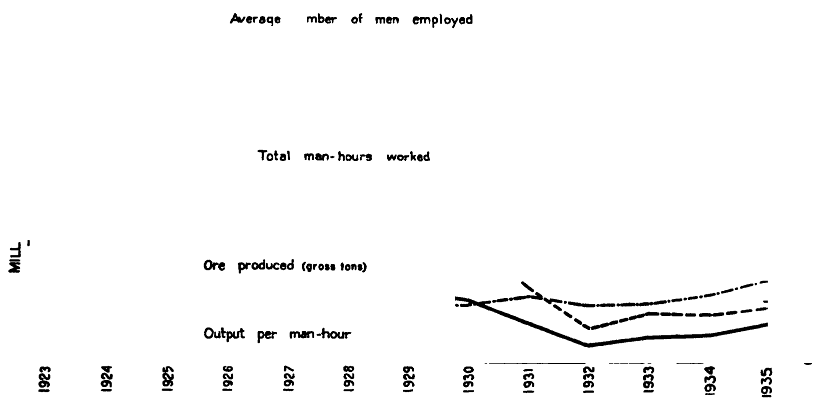


FIGURE 35.—Trends in production, man-hours worked, output per man-hour, and number of men employed at iron-ore mines in Jefferson County, Ala., 1923–35.

Superior district, one should remember that whereas the ore in the Lake Superior district is considerably richer in iron, the ore from the Jefferson County mines contains enough or almost enough lime to make it self-fluxing. Thus, it should be recognized that the lower iron content is partly offset by the self-fluxing nature of the ore, although it is impossible to show this important characteristic in the productivity figures.

In the Northeastern district the average output of merchantable ore per man-hour increased from 0.639 ton in 1934 to 0.917 ton in 1935. The rise in productivity was due chiefly to the large increase in output of the Cornwall open pit at Miners Village, Pa., where a relatively high output per man-hour is attainable. Most of the other production in this area comes from underground mines, and the greater part of the ore is subjected to concentration.

The average length of the man-shift in the entire iron-ore industry in 1935 was 8 hours, the same as in 1934. With few exceptions, mines employed the 8-hour shift throughout 1935.

The two following tables, prepared in collaboration with W. W. Adams, show employment at iron-ore mines and beneficiating plants, quantity and tenor of ore produced, and the average output per man by districts for 1923–35 and by States for 1934–35. Corresponding statistics by States for 1923–32, as well as other supplementary data, are given in the chapter on Iron Ore, Pig Iron, Ferro-Alloys, and Steel in Minerals Yearbook, 1934 (pp. 322–339).

Employment at iron-ore mines and beneficiating plants, quantity and tenor of ore produced, and average output per man, 1923–35, by districts

[Exclusive of ore containing 5 percent or more manganese]

Year	Employment: Average number of men employed	Employment: Time employed: Average number of days	Employment: Time employed: Total man-shifts	Employment: Time employed: Man-hours: Average per shift	Employment: Time employed: Man-hours: Total	Production: Crude ore (partly estimated), gross tons	Production: Merchantable ore: Gross tons	Production: Merchantable ore: Iron (natural) contained: Gross tons	Production: Merchantable ore: Iron (natural) contained: Percent	Average per man (gross tons): Crude ore (partly estimated): Per shift	Average per man (gross tons): Crude ore (partly estimated): Per hour	Average per man (gross tons): Merchantable ore: Per shift	Average per man (gross tons): Merchantable ore: Per hour	Average per man (gross tons): Merchantable ore: Iron (natural) contained: Per shift	Average per man (gross tons): Merchantable ore: Iron (natural) contained: Per hour
UNITED STATES															
1923	41, 294	286	11, 797, 682	9. 1	107, 551, 244	80, 669, 623	69, 351, 442	34, 970, 464	50. 42	6. 838	0. 750	5. 878	0. 645	2. 964	0. 325
1924	38, 765	263	10, 201, 678	9. 0	91, 324, 498	61, 458, 841	54, 267, 419	27, 082, 183	49. 91	6. 024	. 673	5. 319	. 594	2. 655	. 297
1925	35, 757	270	9, 665, 877	8. 9	86, 286, 684	70, 474, 965	61, 907, 997	31, 090, 824	50. 22	7. 291	. 817	6. 405	. 717	3. 217	. 360
1926	34, 399	273	9, 395, 178	9. 0	84, 225, 524	75, 943, 775	67, 623, 000	34, 099, 262	50. 43	8. 083	. 902	7. 198	. 803	3. 629	. 405
1927	34, 755	264	9, 177, 979	8. 9	82, 004, 761	69, 923, 057	61, 741, 100	30, 879, 989	50. 02	7. 619	. 853	6. 727	. 753	3. 365	. 377
1928	30, 238	265	8, 008, 647	8. 9	71, 403, 631	70, 940, 916	62, 197, 088	31, 149, 584	50. 08	8. 858	. 994	7. 766	. 871	3. 889	. 436
1929	30, 763	281	8, 638, 234	8. 9	77, 111, 086	83, 164, 881	73, 027, 720	36, 637, 660	50. 17	9. 628	1. 079	8. 454	. 947	4. 241	. 475
1930	30, 975	259	8, 037, 096	8. 9	71, 620, 115	68, 551, 913	58, 408, 664	29, 212, 457	50. 01	8. 529	. 957	7. 267	. 816	3. 635	. 408
1931	22, 867	201	4, 596, 504	8. 9	40, 928, 283	35, 563, 994	31, 131, 502	15, 625, 050	50. 19	7. 737	. 869	6. 773	. 761	3. 399	. 382
1932	12, 649	145	1, 828, 002	9. 0	16, 427, 009	11, 181, 678	9, 846, 916	4, 948, 243	50. 25	6. 117	. 681	5. 387	. 599	2. 707	. 301
1933	15, 125	140	2, 121, 494	8. 5	17, 931, 479	21, 225, 958	17, 553, 188	8, 777, 574	50. 01	10. 005	1. 184	8. 274	. 979	4. 137	. 490
1934	16, 513	193	3, 186, 232	8. 0	25, 478, 440	28, 252, 926	24, 587, 616	12, 384, 257	50. 37	8. 867	1. 109	7. 717	. 965	3. 887	. 486
1935	14, 987	219	3, 277, 995	8. 0	26, 281, 693	35, 367, 816	30, 540, 252	15, 361, 718	50. 30	10. 789	1. 346	9. 317	1. 162	4. 686	. 585
LAKE SUPERIOR															
1923	28, 756	292	8, 397, 782	8. 8	74, 197, 870	63, 737, 822	59, 394, 180	30, 860, 060	51. 96	7. 590	. 859	7. 073	. 800	3. 675	. 416
1924	27, 651	269	7, 449, 720	8. 7	64, 679, 800	47, 561, 165	44, 942, 898	23, 351, 488	51. 96	6. 384	. 735	6. 033	. 695	3. 135	. 361
1925	25, 472	268	6, 837, 245	8. 6	58, 916, 445	55, 569, 424	52, 163, 922	27, 160, 188	52. 07	8. 127	. 943	7. 629	. 885	3. 972	. 461
1926	24, 483	271	6, 645, 613	8. 6	57, 094, 412	60, 410, 352	57, 272, 643	29, 737, 718	51. 92	9. 090	1. 058	8. 618	1. 003	4. 475	. 521
1927	24, 904	258	6, 424, 947	8. 6	55, 268, 641	54, 744, 797	51, 627, 335	26, 647, 001	51. 61	8. 521	. 991	8. 035	. 934	4. 147	. 482
1928	20, 881	266	5, 562, 599	8. 6	47, 996, 087	56, 059, 314	52, 525, 581	27, 061, 370	51. 52	10. 078	1. 168	9. 443	1. 094	4. 865	. 564
1929	21, 811	286	6, 243, 609	8. 7	54, 615, 027	67, 609, 545	62, 825, 826	32, 294, 527	51. 40	10. 829	1. 238	10. 062	1. 150	5. 172	. 591
1930	22, 301	261	5, 823, 736	8. 8	51, 197, 616	54, 323, 659	49, 383, 385	25, 295, 164	51. 22	9. 328	1. 061	8. 480	. 965	4. 343	. 494
1931	16, 487	207	3, 404, 984	8. 8	30, 017, 397	28, 188, 521	25, 877, 416	13, 408, 123	51. 81	8. 279	. 939	7. 600	. 862	3. 938	. 447
1932	8, 768	163	1, 427, 926	8. 9	12, 638, 707	9, 160, 742	8, 139, 427	4, 267, 074	52. 42	6. 415	. 725	5. 700	. 644	2. 988	. 338

1933	11,598	130	1,512,172	8.3	12,586,959	16,608,574	14,611,032	7,571,079	51.82	10.983	1.320	9.662	1.161	5.007	.602
1934	12,006	199	2,391,091	8.0	19,120,480	22,862,450	21,031,019	10,880,320	51.73	9.562	1.196	8.796	1.100	4.550	.569
1935	10,360	227	2,347,491	8.0	18,826,120	29,033,951	25,368,637	13,211,540	52.09	12.368	1.542	10.807	1.348	5.629	.702
SOUTHEASTERN															
1923	9,220	286	2,633,776	10.2	26,836,560	13,866,000	7,383,403	2,771,682	37.54	5.265	.517	2.803	.275	1.052	.103
1924	8,428	267	2,254,179	9.9	22,394,244	11,791,000	7,388,822	2,742,748	37.12	5.231	.527	3.278	.330	1.217	.122
1925	7,995	287	2,295,030	10.0	22,860,533	12,395,000	7,455,085	2,783,059	37.33	5.401	.542	3.248	.326	1.213	.122
1926	6,992	285	1,989,600	10.4	20,608,685	11,674,198	7,102,607	2,659,468	37.44	5.868	.566	3.570	.345	1.337	.129
1927	6,737	271	1,825,168	10.3	18,872,054	10,965,528	6,714,810	2,498,225	37.20	6.008	.581	3.679	.356	1.369	.132
1928	6,383	259	1,654,319	10.2	16,827,784	11,281,000	6,537,726	2,451,191	37.49	6.819	.670	3.952	.389	1.482	.146
1929	5,917	260	1,541,248	10.0	15,391,042	11,138,675	6,645,237	2,497,520	37.58	7.227	.724	4.312	.432	1.620	.162
1930	5,303	254	1,347,721	9.8	13,145,780	10,039,100	5,838,105	2,196,940	37.63	7.449	.764	4.332	.444	1.630	.167
1931	3,752	195	731,303	9.6	7,011,326	5,364,000	3,644,606	1,359,470	37.30	7.335	.765	4.984	.520	1.859	.194
1932	2,891	106	305,489	9.7	2,964,520	1,634,925	1,375,459	514,142	37.40	5.352	.551	4.502	.464	1.683	.173
1933	3,025	171	515,862	8.9	4,583,196	3,785,589	2,159,958	811,077	37.55	7.338	.826	4.187	.471	1.572	.177
1934	2,987	195	582,511	8.0	4,664,688	3,867,738	2,347,625	883,250	37.62	6.640	.829	4.030	.503	1.516	.189
1935	3,356	208	698,826	8.0	5,601,127	4,172,303	3,295,684	1,209,267	36.69	5.970	.745	4.716	.588	1.730	.216
NORTHEASTERN															
1923	2,418	220	531,780	8.7	4,634,464	2,277,701	1,843,096	946,525	51.36	4.283	.491	3.466	.398	1.780	.204
1924	1,790	151	270,748	8.9	2,414,316	1,253,305	1,128,481	549,179	48.67	4.629	.519	4.168	.467	2.028	.227
1925	1,519	222	337,770	8.7	2,949,278	1,521,014	1,302,841	612,835	47.04	4.503	.516	3.857	.442	1.814	.208
1926	2,077	250	519,808	8.8	4,594,321	2,395,664	1,943,471	997,575	51.33	4.609	.521	3.739	.423	1.919	.217
1927	2,213	293	649,069	8.7	5,633,706	2,984,673	2,244,254	1,124,976	50.13	4.598	.530	3.458	.398	1.733	.200
1928	1,977	244	482,305	8.5	4,093,401	2,381,804	1,986,959	1,034,908	52.09	4.938	.582	4.120	.485	2.146	.253
1929	2,097	269	563,692	8.5	4,787,157	2,843,595	2,195,601	1,140,708	51.95	5.045	.594	3.895	.459	2.024	.238
1930	2,731	262	714,189	8.5	6,058,999	3,107,185	2,248,682	1,238,005	55.05	4.351	.513	3.149	.371	1.733	.204
1931	1,688	175	295,217	8.7	2,570,050	1,224,797	936,960	509,590	54.39	4.149	.477	3.174	.365	1.726	.198
1932	585	101	58,906	9.0	530,682	218,990	165,009	78,960	47.85	3.718	.413	2.801	.311	1.340	.149
1933	310	186	57,625	8.2	474,644	445,825	396,228	190,213	48.01	7.737	.939	6.876	.835	3.301	.401
1934	1,263	142	178,930	8.0	1,422,916	1,222,710	908,944	459,258	50.53	6.833	.859	5.080	.639	2.567	.323
1935	1,029	179	183,856	8.0	1,471,869	1,634,878	1,349,247	662,656	49.11	8.892	1.111	7.339	.917	3.604	.450
WESTERN															
1923	900	260	234,344	8.0	1,882,350	788,100	730,763	392,197	53.67	3.363	.419	3.118	.388	1.674	.208
1924	896	253	227,031	8.1	1,836,138	853,371	807,218	438,768	54.36	3.759	.465	3.556	.440	1.933	.239
1925	771	254	195,832	8.0	1,560,428	989,527	986,149	534,742	54.23	5.053	.634	5.036	.632	2.731	.343
1926	847	284	240,157	8.0	1,928,106	1,463,561	1,304,279	704,501	54.01	6.094	.759	5.431	.676	2.934	.365
1927	901	309	278,795	8.0	2,230,360	1,228,059	1,154,701	609,787	52.81	4.405	.551	4.142	.518	2.187	.273
1928	997	310	309,424	8.0	2,486,359	1,218,798	1,146,822	602,115	52.50	3.939	.490	3.706	.461	1.946	.242
1929	938	309	289,685	8.0	2,317,860	1,573,066	1,361,056	704,905	51.79	5.430	.679	4.698	.587	2.433	.304
1930	640	237	151,450	8.0	1,217,720	1,081,969	938,492	482,348	51.40	7.144	.889	6.197	.771	3.185	.396
1931	940	176	165,000	8.1	1,329,510	786,676	672,520	347,867	51.73	4.768	.592	4.076	.506	2.108	.262
1932	405	88	35,681	8.2	293,100	167,021	167,021	88,067	52.73	4.681	.570	4.681	.570	2.468	.300
1933	192	187	35,835	8.0	286,680	385,970	385,970	205,205	53.17	10.771	1.346	10.771	1.346	5.726	.716
1934	257	131	33,700	8.0	270,356	300,028	300,028	161,429	53.80	8.903	1.110	8.903	1.110	4.790	.597
1935	242	198	47,822	8.0	382,577	526,684	526,684	275,255	52.26	11.013	1.377	11.013	1.377	5.756	.719

Employment at iron-ore mines and beneficiating plants, quantity and tenor of ore produced, and average output per man, 1934–35, by districts and States

[Exclusive of ore containing 5 percent or more manganese]

District and State	Employment					Production									
	Average number of men employed	Time employed				Crude ore (partly estimated), gross tons	Merchantable ore			Average per man (gross tons)					
		Average number of days	Total man-shifts	Man-hours			Gross tons	Iron (natural) contained		Crude ore (partly estimated)		Merchantable ore			
				Average per shift	Total			Gross tons	Percent	Per shift	Per hour	Per shift	Per hour	Iron (natural) contained, Per shift	Iron (natural) contained, Per hour
1934															
Lake Superior:															
Michigan	4,885	192	938,068	8.0	7,505,151	5,039,144	5,039,144	2,612,255	51.84	5.372	0.671	5.372	0.671	2.785	0.348
Minnesota	6,717	201	1,347,498	8.0	10,779,945	17,221,301	15,389,870	7,945,555	51.63	12.780	1.598	11.421	1.428	5.897	.737
Wisconsin	404	261	105,525	7.9	835,384	602,005	602,005	322,510	53.57	5.705	.721	5.705	.721	3.056	.386
	12,006	199	2,391,091	8.0	19,120,480	22,862,450	21,031,019	10,880,320	51.73	9.562	1.196	8.796	1.100	4.550	.569
Southeastern:															
Alabama	2,927	198	579,796	8.0	4,638,936	3,859,972	2,343,819	881,583	37.61	6.657	.832	4.042	.505	1.521	.190
Georgia							164								
Tennessee	60	45	2,715	9.5	25,752	7,766	3.345	1,667	43.80	2.860	.302	1.402	.148	.614	.065
Virginia							297								
	2,987	195	582,511	8.0	4,664,688	3,867,738	2,347,625	883,250	37.62	6.640	.829	4.030	.503	1.516	.189
Northeastern:															
New Jersey						239,374	138,685	80,891	58.33						
New York	1,263	142	178,930	8.0	1,422,916	457,886	244,962	165,647	67.62	6.833	.859	5.080	.639	2.567	.323
Pennsylvania						525,450	525,297	212,720	40.50						
	1,263	142	178,930	8.0	1,422,916	1,222,710	908,944	459,258	50.53	6.833	.859	5.080	.639	2.567	.323

Western:															
California						16,333	16,333								
Missouri	127	167	21,246	8.0	170,724	4.104	4,104	97,087	52.92	8.635	1.075	8.635	1.075	4.570	.569
Utah						161,109	161,109								
Washington						1,920	1,920								
Wyoming	130	96	12,454	8.0	99,632	116,562	116,562	64,342	55.20	9.359	1.170	9.359	1.170	5.166	.646
	257	131	33,700	8.0	270,356	300,028	300,028	161,429	53.80	8.903	1.110	8.903	1.110	4.790	.597
	16,513	193	3,186,232	8.0	25,478,440	28,252,926	24,587,616	12,384,257	50.37	8.867	1.109	7.717	.965	3.887	.486
1935															
Lake Superior:															
Michigan	4,391	212	930,773	8.0	7,442,746	5,205,531	5,205,531	2,696,867	51.81	5.593	.699	5.593	.699	2.897	.362
Minnesota	5,434	236	1,283,744	8.0	10,319,576	23,039,937	19,374,623	10,095,483	52.11	17.947	2.233	15.092	1.877	7.864	.978
Wisconsin	535	249	132,974	8.0	1,063,798	788,483	788,483	422,190	53.54	5.930	.741	5.930	.741	3.175	.397
	10,360	227	2,347,491	8.0	18,826,120	29,033,951	25,368,637	13,214,540	52.09	12.368	1.542	10.807	1.348	5.629	.702
Southeastern:															
Alabama	3,264	212	691,090	8.0	5,538,167	4,121,717	3,277,535	1,200,508	36.63	5.964	.744	4.743	.592	1.737	.217
Georgia							3,044	1,480	48.62						
North Carolina	92	84	7,736	8.1	62,960	50,586	54	27	50.00	6.539	.803	2.346	.288	1.132	.139
Tennessee							14,219	6,825	48.00						
Virginia							832	427	51.32						
	3,356	208	698,826	8.0	5,601,127	4,172,303	3,295,684	1,209,267	36.69	5.970	.745	4.716	.588	1.730	.216
Northeastern:															
New Jersey						173,046	72,343	43,182	59.69						
New York	1,029	179	183,856	8.0	1,471,869	481,917	297,266	200,012	67.28	8.892	1.111	7.339	.917	3.604	.450
Pennsylvania						979,915	979,638	419,462	42.82						
	1,029	179	183,856	8.0	1,471,869	1,634,878	1,349,247	662,656	49.11	8.892	1.111	7.339	.917	3.604	.450
Western:															
California						18,734	18,734	11,115	59.33						
Missouri						2,544	2,544	1,311	51.53						
Utah	94	189	17,770	8.0	142,161	161,216	161,210	84,306	52.30	10.554	1.319	10.554	1.319	5.600	.700
Washington						5,062	5,062	2,784	55.00						
Wyoming	148	203	30,052	8.0	240,416	339,134	339,134	175,739	51.82	11.285	1.411	11.285	1.411	5.848	.731
	242	198	47,822	8.0	382,577	526,684	526,684	275,255	52.26	11.013	1.377	11.013	1.377	5.756	.719
	14,987	219	3,277,995	8.0	26,281,693	35,367,816	30,540,252	15,361,718	50.30	10.789	1.346	9.317	1.162	4.686	.585

WORLD PRODUCTION

The following table shows the production of iron ore by countries from 1932 to 1936 so far as statistics are available. Complete returns for 1936 are not yet available, but those for 1935 are nearly complete. Thus, the data for 1935 indicate a production of 141,000,000 metric tons; the United States furnished about 22 percent.

Iron ore produced, 1932–36, by countries, in metric tons

[Compiled by M. T. Latus]

Country	1932	1933	1934	1935	1936
North America:					
Cuba [1]	82, 610	169, 490	181, 121	228, 408	456, 827
Mexico	27, 122	77, 714	105, 799	120, 000	130, 000
Newfoundland	322, 960	326, 041	514, 747	677, 137	907, 646
United States	10, 004, 959	17, 834, 917	24, 982, 047	31, 030, 423	49, 571, 804
South America:					
Brazil [2]	30, 000	30, 000	30, 000	30, 000	30, 000
Chile [3]	172, 681	559, 598	969, 285	841, 300	1, 347, 831
Europe:					
Austria	306, 796	267, 032	466, 835	775, 421	1, 024, 288
Belgium	92, 810	106, 200	115, 890	164, 520	(4)
Czechoslovakia	602, 215	428, 772	538, 742	731, 058	(4)
France	27, 599, 320	30, 245, 000	32, 015, 000	32, 045, 000	33, 187, 000
Germany [5]	1, 319, 142	2, 534, 768	4, 213, 869	5, 851, 634	(4)
Greece	46, 022	85, 221	147, 408	204, 146	(4)
Hungary	52, 864	50, 021	68, 862	192, 396	279, 549
Italy	412, 326	507, 995	484, 583	551, 454	(4)
Luxemburg	3, 212, 618	3, 362, 417	3, 833, 847	4, 133, 808	4, 896, 000
Norway	373, 907	473, 863	567, 414	765, 152	(4)
Poland	76, 869	160, 661	247, 365	332, 536	466, 659
Portugal	-----------	4, 500	2, 895	880	(4)
Rumania	8, 051	13, 831	83, 590	93, 408	(4)
Spain	1, 760, 471	1, 815, 484	2, 094, 001	2, 633, 165	(4)
Sweden	3, 298, 989	2, 698, 750	5, 253, 058	7, 932, 854	(4)
Switzerland [6]	11, 862	7, 089	18, 961	5, 894	(4)
U. S. S. R. (Russia) [7]	12, 085, 700	14, 454, 500	21, 508, 800	26, 845, 000	27, 918, 000
United Kingdom: Great Britain [8]	7, 445, 807	7, 581, 481	10, 756, 765	11, 070, 256	(4)
Yugoslavia	26, 635	52, 465	179, 841	234, 730	450, 859
Asia:					
China [9]	2, 248, 812	2, 313, 048	2, 544, 613	(10)	(4)
Chosen	390, 937	258, 267	176, 008	228, 220	(4)
India, British	1, 788, 757	1, 248, 344	1, 947, 685	2, 402, 244	(4)
Indochina	-----------	420	1, 500	630	(4)
Japan	226, 722	320, 670	431, 681	515, 529	(4)
Philippine Islands [6]	(11)	-----------	7, 239	283, 311	(4)
Unfederated Malay States	699, 224	778, 774	1, 153, 876	1, 434, 293	1, 681, 102
U. S. S. R. (Russia)	(7)	(7)	(7)	(7)	(7)
Africa:					
Algeria	466, 936	761, 454	1, 326, 437	1, 674, 628	1, 880, 800
Belgian Congo	14, 614	(10)	(10)	(10)	(4)
Egypt	25	-----------	203	15	(4)
Morocco, Spanish [6]	171, 182	515, 838	824, 812	1, 167, 606	(4)
Northern Rhodesia	722	-----------	-----------	-----------	-----------
Sierra Leone	-----------	24, 944	233, 148	440, 498	(4)
Tunisia	209, 000	291, 000	546, 500	503, 000	722, 000
Union of South Africa [1]	16, 024	60, 060	228, 913	304, 046	365, 888
Oceania:					
Australia:					
New South Wales	-----------	2, 471	-----------	7, 785	(4)
Queensland	8, 364	8, 690	3, 282	1, 137	(4)
South Australia	546, 562	732, 760	1, 264, 205	1, 898, 712	(4)
New Zealand	-----------	[12] 6, 588	2, 851	10, 817	(4)
	76, 200, 000	91, 200, 000	120, 100, 000	141, 000, 000	(4)

1 Shipments.
2 Approximate production.
3 Production of Tofo mines.
4 Data not available.
5 Exclusive of manganiferous iron ore carrying 12 to 30 percent manganese.
6 Exports.
7 Russia in Asia included with Russia in Europe.
8 Exclusive of bog ore, which is used mainly for the purification of gas.
9 Including Manchuria.
10 Estimate included in total.
11 Less than 1 ton.
12 Quantity smelted; production not available.

PIG IRON

Production and shipments.—Domestic production of pig iron, exclusive of ferro-alloys, increased 45 percent in 1936 over 1935. The output in 1936 comprised 30,176,971 gross tons using coke as fuel and 77,051 tons made with charcoal. Pennsylvania, second to Ohio in 1935, regained first place in 1936. Of the pig iron manufactured in 1936, it is calculated that 1,131,970 tons, valued at $21,857,096, were made from 1,875,723 tons of foreign ores from Africa, Asia, Australia, Brazil, Chile, Cuba, India, Newfoundland, Sweden, and the U. S. S. R. (Russia), indicating an average yield of 60.35 percent from imported ore. Domestic ore (49,959,534 tons) and 4,424,854 tons of cinder, scale, and purchased scrap, amounting in all to 54,384,388 tons, were reported used in the manufacture of 29,122,052 tons of pig iron, indicating an average pig-iron yield from domestic materials of 53.55 percent. In addition, 1,183,000 tons of home scrap and 1,340,600 tons of flue dust were consumed in making pig iron in 1936.

Shipments of pig iron, exclusive of ferro-alloys, were 30,798,958 gross tons, valued at $541,693,504 in 1936, an increase over 1935 of 45 percent in quantity and 51 percent in total value. Shipments of pig iron were still 19 percent below the 1925-29 average. The values given represent the approximate amounts received for the iron, f. o. b. furnaces, and do not include freight costs, selling commissions, and other items that are figured in some of the market prices of pig iron published in trade journals.

Pig iron produced and shipped in the United States, 1935–36, by States

State	Produced		Shipped from furnaces			
	1935	1936	1935		1936	
	Gross tons	Gross tons	Gross tons	Value	Gross tons	Value
Alabama	1,297,960	1,998,212	1,324,942	$19,437,381	2,061,534	$30,942,051
Colorado	(1)	(1)	(1)	(1)	(1)	(1)
Illinois	2,014,116	2,917,016	2,224,132	39,092,488	2,991,740	54,583,804
Indiana	2,124,241	3,230,537	2,182,798	38,809,232	3,256,677	59,067,654
Iowa	(1)	(1)	(1)	(1)	(1)	(1)
Kentucky	213,837	225,214	213,837	(1)	225,214	(1)
Maryland	863,308	1,216,065	863,861	(1)	1,219,852	(1)
Massachusetts		(1)	(1)	(1)	(1)	(1)
Michigan	774,237	937,762	781,458	12,225,499	873,341	13,585,519
Minnesota	(1)	106,768	(1)	(1)	101,475	(1)
New York	1,451,394	2,190,478	1,479,921	23,603,728	2,216,751	35,181,959
Ohio	5,634,530	7,206,762	5,600,757	93,530,895	7,351,407	125,087,158
Pennsylvania	5,479,792	9,105,058	5,549,538	102,027,692	9,379,615	176,552,170
Tennessee	(1)	(1)	(1)	(1)	(1)	(1)
Utah	(1)	(1)	(1)	(1)	(1)	(1)
Virginia	(1)		(1)	(1)	(1)	(1)
West Virginia	686,350	641,736	672,104	(1)	669,208	(1)
Undistributed	[2] 287,431	[2] 478,414	[2] 285,005	[2] 29,418,584	[2] 452,144	[2] 46,693,189
	20,827,196	30,254,022	21,178,353	358,145,499	30,798,958	541,693,504

[1] Included under "Undistributed."
[2] Includes statistics for States entered as (1) above.

Pig iron shipped from blast furnaces in the United States, 1935–36, by grades

Grade	1935			1936		
	Gross tons	Value		Gross tons	Value	
		Total	Average		Total	Average
Charcoal	82,969	$1,688,196	$20.35	86,047	$1,846,319	$21.46
Foundry	1,924,141	32,417,342	16.85	2,403,539	41,402,830	17.23
Basic	14,030,001	228,351,983	16.28	21,191,702	362,997,726	17.13
Bessemer	3,792,064	69,893,237	18.43	5,156,290	96,868,954	18.79
Low-phosphorus	148,686	3,263,967	21.95	198,762	4,422,997	22.25
Malleable	1,102,155	20,501,306	18.60	1,647,050	31,627,815	19.20
Forge	10,226	187,309	18.32	28,446	551,133	19.37
All other (not ferro-alloys)	88,111	1,842,159	20.91	87,122	1,976,230	22.68
	21,178,353	358,145,499	16.91	30,798,958	541,693,504	17.59

The number of furnaces in blast on June 30 and December 31 and the total number of stacks recorded for 1935 and 1936, exclusive of electric reduction furnaces, were as follows:

Blast furnaces (including ferro-alloy blast furnaces) in the United States, 1935–36 [1]

State	In blast June 30, 1935	Dec. 31, 1935			In blast June 30, 1936	Dec. 31, 1936		
		In	Out	Total		In	Out	Total
Alabama	7	12	10	22	10	15	5	20
Colorado	1	1	2	3	1	2	1	3
Illinois	8	10	15	25	13	13	10	23
Indiana	6	10	8	18	12	15	3	18
Kentucky	2	1	1	2	1	1	1	2
Maryland	3	4	2	6	4	5	1	6
Massachusetts			1	1	1		1	1
Michigan	6	7		7	6	7		7
Minnesota		1	1	2	1	2		2
Missouri			1	1			1	1
New York	8	8	11	19	12	13	6	19
Ohio	25	29	23	52	32	38	12	50
Pennsylvania	26	35	50	85	46	60	24	84
Tennessee	1	1	4	5	2	1	4	5
Utah	1	1		1	1	1		1
Virginia	1	1	5	6	1		1	1
West Virginia	2	3		3	3	3		3
	97	124	134	258	146	176	70	246

[1] American Iron and Steel Institute.

Value at blast furnaces.—The average value of all kinds of pig iron given in the accompanying table is based on the reports of the manufacturers to the Bureau of Mines. The figures represent the approximate values, f. o. b. blast furnaces, and do not include the values of ferro-alloys. The general average value for all grades of pig iron at the furnaces was $17.59 a gross ton in 1936—$0.68 more than in 1935 but $1.01 less than the 1925–29 average.

Average value per gross ton of pig iron at blast furnaces in the United States, 1932–36

State	1932	1933	1934	1935	1936
Alabama	$11.01	$11.53	$13.81	$14.67	$15.01
Illinois	15.77	15.80	17.72	17.58	18.24
Indiana	15.45	15.42	17.60	17.78	18.14
Michigan	15.22	15.19	15.49	15.64	15.56
New York	14.38	14.50	15.20	15.95	15.87
Ohio	15.12	14.56	16.45	16.70	17.02
Pennsylvania	15.83	15.89	18.06	18.38	18.82
Other States [1]	13.40	14.00	15.75	14.46	17.50
Average for United States	14.80	14.86	16.73	16.91	17.59

[1] 1932-36: Colorado, Iowa, Kentucky, Maryland, Massachusetts, Minnesota, Tennessee, Utah, Virginia, and West Virginia.

Commercial quotations.—According to published market quotations, the average monthly prices of foundry, basic, and bessemer pig iron at Valley furnaces and of foundry pig iron at Birmingham furnaces are summarized in the following table.

Average monthly prices per ton of chief grades of pig iron, 1935–36 [1]

Month	Foundry pig iron at Valley furnaces		Foundry pig iron at Birmingham furnaces		Bessemer pig iron at Valley furnaces		Basic pig iron at Valley furnaces	
	1935	1936	1935	1936	1935	1936	1935	1936
January	$18.50	$19.50	$14.50	$15.50	$19.00	$20.00	$18.00	$19.00
February	18.50	19.50	14.50	15.50	19.00	20.00	18.00	19.00
March	18.50	19.50	14.50	15.50	19.00	20.00	18.00	19.00
April	18.50	19.50	14.50	15.50	19.00	20.00	18.00	19.00
May	18.50	19.50	14.50	15.50	19.00	20.00	18.00	19.00
June	18.50	19.50	14.50	15.50	19.00	20.00	18.00	19.00
July	18.50	19.50	14.50	15.50	19.00	20.00	18.00	19.00
August	18.50	19.50	14.50	15.50	19.00	20.00	18.00	19.00
September	18.50	19.50	14.50	15.50	19.00	20.00	18.00	19.00
October	18.50	19.50	14.50	15.50	19.00	20.00	18.00	19.00
November	19.50	19.71	14.74	15.75	20.00	20.21	19.00	19.21
December	19.50	20.50	15.50	16.88	20.00	21.00	19.00	20.00
Average	18.67	19.60	14.60	15.64	19.17	20.10	18.17	19.10

[1] Metal Statistics, 1937.

Foreign trade in pig iron.—The imports of pig iron for consumption in 1936 increased 27 percent over 1935 and totaled 165,808 gross tons. Netherlands, with 36 percent (60,363 tons), and India, with 33 percent (55,426 tons), were the chief sources of supply in 1936.

Pig iron imported into the United States, 1932–36, by countries, in gross tons

Country	1932	1933	1934	1935	1936
North America:					
Canada	2,113	12,259	8,984	13,771	11,603
South America:					
Chile			89		
Nicaragua					689
Europe:					
Belgium	200	225	100	100	973
Czechoslovakia					37
France	97			50	
Germany	361	200	100	4,877	4,749
Netherlands	74,372	68,341	65,439	48,122	60,363
Norway	140	806	1,203	2,420	2,649
Sweden	561	632	991	907	
U. S. S. R. (Russia)				9,124	24,556
United Kingdom	23,378	5,495	600	14,500	4,354
Asia:					
Hong Kong					200
India, British	28,820	68,036	36,013	37,016	55,426
Japan	279	208		50	
Kwantung	309	2,394	969		209
	130,630	158,596	114,488	130,937	165,808
Value	$1,301,625	$1,439,206	$1,465,475	$1,979,324	$2,336,236

Exports of pig iron from the United States were 5,316 gross tons in 1936 compared with 4,107 tons in 1935. Japan (2,205 tons) and Canada (674 tons) were the chief customers in 1936.

Pig iron exported from the United States, 1935–36, by countries, in gross tons

Country	1935	1936	Country	1935	1936
North America:			Europe—Continued.		
Canada	1,296	674	Poland and Danzig	56	----------
Cuba	50	42	United Kingdom	10	30
Mexico	350	183	Other countries	----------	140
Panama	320	239	Asia:		
Other countries	4	120	China	275	20
South America:			Japan	652	2,205
Colombia	123	148	Philippine Islands	437	437
Peru	204	----------	Oceania: New Zealand	17	----------
Other countries	62	53	Africa: Union of South Africa	----------	453
Europe:					
Belgium	191	467		4,107	5,316
Germany	60	105	Value	$96,272	$119,362

World production of pig iron.—World production of pig iron (including ferro-alloys) in 1936 was approximately 93,000,000 metric tons, an increase of 23 percent over 1935 and 8 percent above the 1925–29 average. In 1936 the United States supplied 34 percent of the world output of pig iron compared with 29 percent in 1935, in consequence of a 45-percent increase in United States production in 1936 over 1935 compared with a 14-percent increase for the rest of the world.

Pig iron (including ferro-alloys) produced, 1932–36, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1932	1933	1934	1935	1936
Australia	[2] 400,000	[2] 340,000	[2] 500,000	[2] 630,000	[2] 690,000
Austria	94,466	87,949	133,492	193,170	248,111
Belgium	2,748,740	2,710,430	2,952,520	3,060,447	3,207,409
Brazil	28,809	46,772	56,924	55,070	[2] 60,000
Canada	162,179	261,582	441,916	667,028	764,818
China	522,464	606,697	631,440	[2] 650,000	[2] 650,000
Chosen	163,653	163,937	210,808	245,196	250,000
Czechoslovakia	450,106	498,980	600,324	810,938	1,107,000
Finland	13,671	12,004	7,577	11,035	[2] 12,000
France	5,537,460	6,359,000	6,142,000	5,790,000	6,237,000
Germany (exclusive of the Saar)	3,932,364	5,265,000	8,716,739	12,539,451	15,300,000
Saar	1,349,493	1,591,200	1,825,670	1,938,055	2,160,000
Hungary	66,281	93,072	140,220	185,883	306,290
India, British	928,345	1,082,664	1,347,024	1,489,574	1,585,000
Italy	494,667	566,895	581,455	703,836	[2] 800,000
Japan	1,036,680	1,456,880	1,772,380	1,864,452	[2] 1,900,000
Luxemburg	1,958,930	1,887,538	1,995,193	1,872,372	1,986,604
Mexico	20,381	53,500	66,458	64,139	[2] 75,000
Netherlands	236,426	252,645	257,841	253,616	274,883
New Zealand	----------	3,339	1,358	4,981	[2] 5,000
Norway	103,092	112,653	126,932	130,751	[2] 130,000
Philippine Islands	168	100	[2] 150	[2] 200	[2] 200
Poland	198,674	305,625	381,587	394,097	581,869
Rumania	8,752	2,013	61,635	81,989	90,000
Spain	300,617	338,853	372,366	354,776	251,000
Sweden	282,163	345,526	558,129	612,596	584,000
Union of South Africa	13,107	26,492	[2] 130,600	173,725	[2] 200,000
U. S. S. R. (Russia)	6,176,800	7,130,700	10,495,300	12,606,100	14,319,000
United Kingdom	3,631,363	4,202,383	6,064,802	6,527,105	7,808,600
United States	8,920,878	13,590,926	16,398,077	21,715,541	31,571,224
Yugoslavia	9,973	30,756	32,620	21,793	44,453
	39,790,000	49,426,000	63,003,000	75,600,000	93,000,000

[1] In addition to countries listed, pig iron is produced in Chile, but production figures are not available.
[2] Approximate production.

FERRO-ALLOYS

Production and shipments.—The production of ferro-alloys was 818,488 gross tons in 1936, compared with 545,316 tons in 1935, an increase of 50 percent. Ferro-alloys were made in 1936 at 12 blast furnaces, 15 electric furnace plants, and 2 aluminothermic plants; in addition, 2 plants made ferrophosphorus and 1 plant made ferrosilicon as a byproduct.

The shipments of all classes of ferro-alloys totaled 853,531 gross tons valued at $69,135,074 in 1936, an increase of 44 percent in quantity and 41 percent in total value over 1935. Compared with the 5-year average for 1925–29, which amounted to 715,250 tons, the 1936 shipments increased 19 percent.

Ferro-alloys shipped from furnaces in the United States, 1935–36, by varieties

Variety of alloy	1935		1936	
	Gross tons	Value	Gross tons	Value
Ferromanganese	194,627	$16,374,328	322,353	$24,088,298
Spiegeleisen	54,793	1,303,574	92,336	2,249,217
Ferrosilicon (7 percent or more silicon)	263,264	11,630,793	325,210	15,176,800
Ferrophosphorus	(1)	(1)	19,341	1,279,143
Ferrotungsten	1,501	3,167,301	1,812	3,912,037
Ferrovanadium	814	(2)	(1)	(1)
Other varieties [3]	77,177	[2] 16,415,596	92,479	22,429,579
	592,176	48,891,592	853,531	69,135,074

[1] Included with "Other varieties."
[2] Value of ferrovanadium included with "Other varieties."
[3] 1935: Ferrochromium, ferromolybdenum and calcium-molybdenum compounds, ferrophosphorus, ferrotitanium, ferrozirconium, silicomanganese, silicospiegeleisen, ferrocolumbium, and zirconiumferrosilicon; 1936: Ferrochromium, ferromolybdenum and calcium-molybdenum compounds, ferrotitanium, ferrovanadium, ferrozirconium, silicomanganese, silicospiegeleisen, ferrocolumbium, and zirconiumferrosilicon.

Ferromanganese.—The shipments of ferromanganese in 1936 increased 66 percent over those of 1935 and totaled 322,353 gross tons. Compared with the 5-year average for 1925–29 (303,883 tons) the 1936 shipments increased 6 percent. The average value per ton, f. o. b. furnaces, reported for ferromanganese was $74.73 in 1936, compared with $84.13 in 1935.

The production of ferromanganese in 1936, amounting to 316,000 gross tons containing 249,933 tons of manganese (79.09 percent manganese), was made at six blast furnaces and two electric furnace plants. In 1935, the production, which was 214,290 tons containing 170,168 tons of manganese (79.41 percent manganese), was made at five blast furnaces and two electric furnace plants. In both years the bulk of the output was made in blast furnaces.

Ferromanganese produced in the United States and metalliferous materials consumed in its manufacture, 1932–36

Year	Ferromanganese produced			Materials consumed (gross tons)				Manganese ore used per ton of ferromanganese made (gross tons)
	Gross tons	Manganese contained		Manganese ore		Iron and manganiferous iron ores	Cinder, scale, and purchased scrap	
		Percent	Gross tons	Foreign	Domestic			
1932	56,350	77.66	43,760	90,677	10,666	5,270	1,499	1.798
1933	136,267	79.30	108,059	233,607	10,695	10,795	1,655	1.793
1934	139,171	78.67	109,491	256,980	853	13,933	3,304	1.853
1935	214,290	79.41	170,168	401,846	4,286	9,195	8,921	1.895
1936	316,000	79.09	249,933	595,114	5,987	12,467	2,821	1.902

The tons of manganese ore used per ton of ferromanganese produced increased from 1.793 in 1933 to 1.902 in 1936. Of the total manganese ore used in making ferromanganese in 1936, only 1 percent was mined in the United States; 99 percent came from foreign sources, as shown in the following table.

Quantity and tenor of manganese ore used in manufacture of ferromanganese in the United States, 1935–36

Source of ore	1935		1936	
	Gross tons	Manganese content (percent, natural)	Gross tons	Manganese content (percent, natural)
Africa	69,857	49.58	199,143	49.50
Brazil	47,663	43.84	86,032	44.06
Chile	2,941	44.19	832	47.14
Cuba	56,411	49.39	32,317	48.67
India	76,983	51.06	105,289	51.38
Philippine Islands	520	37.72		
U. S. S. R. (Russia)	147,471	47.48	171,501	47.52
United States	4,286	39.66	5,987	39.67
	406,132	48.24	601,101	48.34

Spiegeleisen.—Shipments of spiegeleisen from domestic furnaces in 1936 increased 69 percent over 1935 and totaled 92,336 gross tons. Shipments, however, were still 8 percent below the 1925–29 average—99,964 tons. The average value per ton at the furnace was $24.36 in 1936 and $23.79 per ton in 1935. Production in 1936 was 95,137 tons, the bulk of which was made in blast furnaces; only a small amount came from electric furnaces. Output in 1936 averaged 20.57 percent manganese. Most of the spiegeleisen was made from domestic ores in 1936, but 31,159 tons of foreign ferruginous manganese ore also were used.

Ferrosilicon.—Shipments of ferrosilicon in 1936 increased 24 percent over 1935 and amounted to 325,210 gross tons. Compared with the 5-year average for 1925–29 (261,688 tons), the 1936 shipments increased 24 percent.

The production of ferrosilicon in 1936 was 294,441 gross tons, including 164,699 tons made by blast furnaces, 129,454 tons by electric furnaces, and 288 tons as a byproduct of the manufacture of artificial abrasives in electric furnaces. The silicon content of the production in 1936 ranged from 7 to 95 percent, but averaged 22.28 percent. Virtually all the raw material used in making ferrosilicon was of domestic origin.

Ferrophosphorus.—Shipments of ferrophosphorus in 1936 totaled 19,341 gross tons valued at $1,279,143. Production was 20,771 gross tons containing 21.54 percent phosphorus. Most of the output was made in blast furnaces. Ferrophosphorus was made entirely from domestic materials in 1936.

Ferrotungsten.—Shipments of ferrotungsten increased 21 percent in 1936 over those of 1935 and amounted to 1,812 gross tons containing about 80 percent tungsten (3,250,621 pounds). The value of the 1936 shipments was $3,912,037, f. o. b. furnaces, or $1.20 per pound of contained tungsten. The 1936 shipments were only 3 percent below the average of 1,864 tons for the 5-year period 1925–29.

The production of ferrotungsten in 1936 was 1,865 gross tons containing 80 percent tungsten (3,341,525 pounds). In addition to domestic ores from Arizona, California, Colorado, Nevada, and Washington, foreign ores from Australia, China, India, and South America were used. All ferrotungsten was made in electric furnaces.

Foreign trade in ferro-alloys.—Imports of all alloys of the rarer metals are not recorded separately but are grouped as shown in the following table. Ferromanganese and spiegeleisen constituted the bulk of the imports in 1935 and 1936. The imports of ferromanganese for consumption (chiefly from Norway and Netherlands) were 37,953 gross tons, an increase of 39 percent over 1935. The imports of spiegeleisen for consumption (chiefly from Canada) were 52,011 gross tons; an increase of 61 percent.

Ferro-alloys and ferro-alloy metals imported for consumption in the United States, 1935–36, by varieties

Variety of alloy	1935			1936		
	Gross weight (gross tons)	Content (gross tons)	Value	Gross weight (gross tons)	Content (gross tons)	Value
Ferromanganese:						
Containing over 1 percent carbon	26,693	21,369	$1,660,120	37,420	30,144	$2,184,423
Containing not over 1 percent carbon	547	460	71,291	533	449	67,528
Manganese silicon (manganese content)	(1)	121	8,468	(1)	126	8,953
Manganese boron, manganese metal, and spiegeleisen not more than 1 percent carbon (manganese content)	(1)	13	8,343	(1)	13	8,968
Spiegeleisen	32,384	(1)	915,134	52,011	(1)	1,404,983
Ferrochrome or ferrochromium:						
Containing 3 percent or more of carbon	61	30	6,112	8	4	826
Containing less than 3 percent of carbon				104	66	15,895
Ferrophosphorus				525	(1)	41,473
Ferrosilicon: Containing 8 percent and less than 60 percent silicon	5,274	781	135,422	3,823	527	78,566
Chrome or chromium metal	49	(1)	61,719	57	(1)	71,354
Chromium and zirconium silicon and calcium silicide	1,203	(1)	150,959	1,768	(1)	224,521
Ferromolybdenum, molybdenum metal and powder, calcium molybdate, and other compounds and alloys of molybdenum (molybdenum content)	(1)	(2)	211	(1)	(3)	213
Ferrotitanium	2	(1)	654	1	(1)	303
Tungsten and combinations, in lumps, grains, or powder:						
Tungsten metal (tungsten content)	(1)	35	64,420	(1)	80	143,178
Tungsten carbide (tungsten content)				(1)	(4)	112
Combinations containing tungsten or tungsten carbide (tungsten content)	(1)	(5)	12,011	(1)	(6)	1,944
Tungsten acid and other compounds of tungsten, n. s. p. f. (tungsten content)	(1)	(7)	1,874	(1)	(8)	1,931

[1] Not recorded.
[2] 39 pounds.
[3] 49 pounds.
[4] 52 pounds.
[5] 1,552 pounds.
[6] 785 pounds.
[7] 537 pounds.
[8] 385 pounds.

Ferromanganese and ferrosilicon imported into the United States, 1935–36, by countries

Country	Ferromanganese (manganese content)				Ferrosilicon (silicon content)			
	1935		1936		1935		1936	
	Gross tons	Value	Gross tons	Value	Gross tons	Value	Gross tons	Value
Canada	40	$4,500	1	$66	781	$135,422	527	$78,566
Czechoslovakia			557	30,609				
France	2,091	193,006	2,151	204,184				
Germany	1,025	64,694	21	2,467				
Italy	709	97,523	126	16,222				
Japan			257	31,155				
Netherlands	1,095	61,166	4,346	261,748				
Norway	14,365	1,156,488	20,655	1,569,844				
Poland and Danzig	157	9,889	1,997	108,346				
Sweden			4	673				
United Kingdom	2,347	144,145	478	26,637				
	21,829	1,731,411	30,593	2,251,951	781	135,422	527	78,566

The exports of ferro-alloys are relatively unimportant. Exports of ferromanganese and spiegeleisen in 1936 were 466 gross tons, while exports of other ferro-alloys were 2,482 tons valued at $806,759.

Ferro-alloys and ferro-alloy metals exported from the United States, 1934–36, by varieties

Variety of alloy	1934		1935		1936	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Ferromanganese [1] Spiegeleisen [1]	222	$12,580	131	$10,389	466	$26,540
Tungsten and ferrotungsten (including tungsten wire)	314	453,813	445	743,592	(1)	(1)
Other ferro-alloys [2]	(1)	(1)	(1)	(1)	2,482	806,759

[1] Not separately classified.
[2] Includes ferrosilicon, ferrotungsten, ferrovanadium, and other ferro-alloys.

STEEL

Production.—The following figures covering the output of steel were compiled by the American Iron and Steel Institute. The total production of steel ingots and castings in 1936 amounted to 47,767,856 gross tons, an increase of 40 percent over 1935 and within 3 percent of the 1925–29 average of 49,320,025 tons. Of the total steel output in 1936, 43,536,128 tons (91 percent) came from open hearths, 3,458,457 tons (7 percent) from bessemer converters, 772,455 tons (1.6 percent) from electric furnaces, and 816 tons from crucible furnaces. In 1935 the production was 34,092,594 tons, of which 30,715,429 tons (90 percent) came from open hearths, 2,835,031 tons (8 percent) from bessemer converters, 541,492 tons (1.6 percent) from electric furnaces, and 642 tons from crucible furnaces. Thus, the output of open-hearth steel increased 42 percent over 1935 while that of bessemer steel increased 22 percent and of electric furnace steel 43 percent. The bulk (43,114,826 tons) of the total open-hearth output in 1936 was made in basic furnaces.

Of the total output of steel ingots and castings shown above, 47,512,809 gross tons were ingots in 1936 compared with 33,940,445 tons of ingots in 1935.

The bulk of the steel output comes from the contiguous States Pennsylvania and Ohio. In 1936 these two States produced 54 percent of the total steel, 52 percent of the open-hearth steel, and 75 percent of the bessemer-steel production.

Open-hearth steel ingots and castings manufactured in the United States, 1932–36, by States, in gross tons

State	1932	1933	1934 [1]	1935 [1]	1936 [1]
New England States	128,227	227,445	209,527	248,778	301,161
New York and New Jersey	589,945	907,512	1,086,189	1,275,496	2,109,946
Pennsylvania	3,506,451	5,733,772	6,477,890	7,850,710	12,913,903
Ohio	2,849,170	5,285,122	5,649,785	7,702,018	9,789,985
Indiana	1,428,091	2,649,190	3,098,343	4,376,998	5,963,501
Illinois	695,936	1,407,581	1,642,437	2,534,811	3,663,011
Other States	2,709,510	4,171,050	5,366,934	6,726,618	8,794,621
	11,907,330	20,381,672	23,531,105	30,715,429	43,536,128

[1] The figures for 1934–36 include only that portion of the steel for castings which was produced in foundries operated by companies producing steel ingots.

Bessemer-steel ingots and castings manufactured in the United States, 1932–36, by States, in gross tons

State	1932	1933	1934 [1]	1935 [1]	1936 [1]
Ohio	939,228	1,219,494	1,017,629	1,361,933	1,639,329
Pennsylvania	233,215	598,672	570,817	764,403	952,971
Illinois	250,983	379,483	299,157	375,445	866,157
Other States	108,650	231,142	274,754	333,250	
	1,532,076	2,428,791	2,162,357	2,835,031	3,458,457

[1] The figures for 1934–36 include only that portion of the steel for castings which was produced in foundries operated by companies producing steel ingots.

Steel electrically manufactured in the United States, 1932–36, in gross tons

Year	Ingots	Castings	Total	Year	Ingots	Castings	Total
1932	141,328	99,783	241,111	1935 [1]	521,818	19,674	541,492
1933	299,808	121,395	421,203	1936 [1]	704,213	68,242	772,455
1934 [1]	349,095	12,201	361,296				

[1] The figures for 1934–36 include only that portion of the steel for castings which was produced in foundries operated by companies producing steel ingots.

The steel-production figure given above for 1936 includes 2,883,622 gross tons of alloy-steel ingots and castings, which represent 6 percent of the total. This figure includes steels in which the minimum of the range specified in any of the elements named exceeds the following percentages: Nickel, over 0.40 percent; chromium, over 0.30 percent; copper, over 0.50 percent; manganese, over 1.65 percent; silicon, over 0.50 percent; molybdenum, over 0.10 percent; vanadium, tungsten, cobalt, titanium, and zirconium, any percent. Although the total steel output increased 40 percent over 1935 in 1936, alloy steels increased 36 percent. Of the total alloy-steel output in 1936, 2,239,885 tons (78 percent) came from basic open hearths, 115,766 tons (4

percent) from acid open hearths, 527,762 tons (18 percent) from electric furnaces, and 209 tons from crucible furnaces.

Production of alloy-steel ingots and castings, 1933–36, by processes, in gross tons

Process	1933	1934 [1]	1935 [1]	1936 [1]
Open hearth, basic	1,169,255	1,278,343	1,633,541	2,239,885
Open hearth, acid	57,097	34,540	73,400	115,766
Bessemer	24,519	53	----------	----------
Crucible	102	103	154	209
Electric	296,210	299,236	412,563	527,762
	1,547,183	1,612,275	2,119,658	2,883,622

[1] The figures for 1934–36 include only that portion of the steel for castings produced in foundries operated by companies manufacturing steel ingots.

From the foregoing table it will be seen that the bulk (68 percent in 1936) of the steel made in the electric furnace is alloy steel. Typically, steels with higher alloy content are made in the electric furnace, and steels with lower alloy content are made by the open-hearth and bessemer processes.

Foreign trade in steel.—Responding to greater demands in world markets in 1936, exports of iron and steel products rose materially over those of 1935. Increases occurred in a wide range of semimanufactured and manufactured products. The larger exports of tin plate and terneplate featured the 1936 trade; exports of tin plate and terneplate were 238,881 gross tons valued at $23,752,978 in 1936 compared with 134,499 tons valued at $13,021,779 in 1935. The exports of steel ingots, blooms, billets, slabs, and sheet bars, however, declined, amounting to 21,400 tons in 1936 compared with 39,782 tons in 1935. Exports of iron and steel scrap were also lower in 1936, when shipments abroad were 1,936,132 tons compared with 2,103,959 tons in 1935, a decrease of 8 percent. Japan with 1,057,621 tons (55 percent), United Kingdom with 364,874 tons (19 percent), and Italy with 285,126 tons (15 percent) were the principal takers of American scrap in 1936.

Iron and steel exported from the United States, 1935–36

Article	1935		1936	
	Gross tons	Value	Gross tons	Value
Semimanufactures:				
Steel ingots, blooms, billets, slabs, and sheet bars	39,782	$900,605	21,400	$607,331
Iron and steel bars and rods:				
Iron bars	1,200	110,126	1,010	93,677
Concrete reinforcement bars	----------	----------	3,592	160,880
Steel bars	52,286	2,630,649	52,063	3,213,675
Alloy-steel bars	2,817	583,447		
Wire rods	26,092	1,012,926	34,872	1,328,486
Iron and steel plates, sheets, skelp, and strips:				
Boiler plates	1,369	83,773	3,506	208,519
Other plates, not fabricated	42,909	1,894,316	92,348	4,252,921
Skelp iron or steel	64,420	2,146,139	70,202	2,278,876
Iron or steel sheets, galvanized	74,997	5,208,474	63,205	4,688,986
Steel sheets, black	100,483	6,549,830	140,158	10,002,781
Iron sheets, black	5,183	349,976	6,964	455,388
Strip band, and scroll iron or steel:				
Cold-rolled	20,145	1,501,674	22,664	1,924,411
Hot-rolled	24,509	1,283,478	39,246	2,072,973
Tin plate and terneplate	134,499	13,021,779	238,881	23,752,978

Iron and steel exported from the United States, 1935–36—Continued

Article	1935 Gross tons	1935 Value	1936 Gross tons	1936 Value
Manufactures—steel-mill products:				
Structural iron and steel:				
Water, oil, gas, and other storage tanks complete and knocked-down material	8,690	$695,950	21,574	$1,733,414
Structural shapes:				
Not fabricated	36,656	1,493,788	62,077	2,583,736
Fabricated	14,980	1,190,809	20,914	1,723,746
Plates fabricated, punched, or shaped	1,611	102,278	3,419	204,636
Metal lath	850	143,802	936	161,384
Frames, sashes, and sheet piling	4,827	319,952	3,701	274,657
Railway track material:				
Rails for railways	51,672	1,454,679	73,455	2,085,126
Rail joints, splice bars, fishplates, and tieplates	5,818	323,764	7,987	426,228
Switches, frogs, and crossings	1,436	234,917	1,738	294,917
Railroad spikes	2,477	143,919	2,383	134,293
Railroad bolts, nuts, washers, and nut locks	557	68,072	795	90,738
Tubular products:				
Boiler tubes	8,644	1,153,770	7,386	1,337,567
Casing and oil-line pipe	23,721	2,401,595	28,410	2,759,957
Seamless black pipe, other than casing and oil-line	2,721	365,438	3,924	586,184
Welded black pipe	18,313	1,463,244	13,839	1,191,895
Welded galvanized pipe	18,080	1,448,289	11,396	988,761
Maleable-iron screwed pipe fittings	3,466	1,050,960	3,657	1,028,873
Cast-iron screwed pipe fittings	1,876	390,288	2,080	551,749
Cast-iron pressure pipe and fittings	11,127	627,214	11,930	700,953
Cast-iron soil pipe and fittings	4,506	291,045	5,942	361,170
Riveted-steel or iron pipe and fittings	476	77,951	1,122	150,341
Wire and manufactures:				
Barbed	31,963	1,713,637	34,042	1,900,964
Galvanized wire	20,856	1,146,870	22,146	1,305,064
Iron or steel wire, uncoated	18,208	1,066,727	25,209	1,601,430
Wire rope	4,040	956,194	3,256	831,718
Woven-wire fencing and screen cloth	3,219	538,977	3,732	667,799
All other	6,021	1,277,286	5,361	1,231,373
Nails and bolts (except railroad):				
Horseshoe nails	676	154,323	737	165,669
Wire nails	11,141	615,651	7,799	472,785
All other nails, including tacks and staples	3,026	349,229	2,554	311,250
Bolts, nuts, rivets, and washers (except railroad)	6,370	1,544,640	6,764	1,609,632
Castings and forgings:				
Horseshoes	199	22,629	120	15,642
Iron and steel, including car wheels and axles	36,548	3,253,630	22,513	2,529,908
Advanced manufactures:				
House heating boilers and radiators		211,096		251,206
Tools:				
Axes		519,357		593,793
Hammers and hatchets		194,566		254,300
Saws, wood and metal cutting		1,076,366		1,401,628
Shovels and spades		184,358		225,856
All other tools		7,112,097		8,469,450

Imports for consumption of iron and steel also gained in 1936 over those of 1935. Of the larger items of steel imports, bars, sheets, and structural shapes recorded the largest gains. Foreign purchases of scrap doubled in 1936 over 1935 and amounted to 153,118 gross tons, with Canada the chief supplier in both years.

Iron and steel imported for consumption in the United States, 1935–36

Article	1935		1936	
	Gross tons	Value	Gross tons	Value
Bar iron	1,855	$88,341	1,374	$80,358
Steel bars, concrete reinforcement	3,108	88,410	3,770	102,738
Hollow bars and hollow drill steel	1,171	154,098	1,930	259,474
Bars, whether solid or hollow	24,768	1,164,847	40,412	1,740,976
Boiler or other plate iron or steel	682	21,339	421	12,715
Steel ingots, blooms, slabs, etc	2,097	115,677	85	12,581
Sheets of iron or steel, common or black, and boiler or other plate iron or steel	9,034	341,406	19,882	728,853
Steel circular saw plates	25	10,378	30	12,091
Sheets and plates and steel, n. s. p. f	1,993	112,717	2,699	143,925
Tin plates, terneplates, and taggers tin	187	48,867	233	62,048
Structural iron and steel	41,601	1,207,544	61,583	1,842,932
Rails and bars for railways and rail braces	5,279	133,740	7,419	163,305
Railway fishplates or splice bars, and tieplates	379	10,403	349	13,435
Cast-iron pipe and fittings	121	8,422	1,117	74,573
Other pipes and tubes	20,584	1,765,311	35,093	12,867,774
Barbed wire	24,948	1,227,822	15,236	864,577
Round iron and steel wire	3,238	515,360	4,531	720,783
Bailing wire	686	36,476	433	22,766
Flat wire and steel strips not thicker than ¼ inch and not over 16 inches wide	1,888	1,088,446	2,887	1,642,038
Wire rope and wire strand	2,142	354,155	2,420	388,891
Wire rods, nail rods, and flat rods	16,780	1,053,085	18,911	1,259,279
Hoop or band iron or steel, cut to lengths, for bailing	10,743	456,107	2,436	95,976
Hoop, bands, strips, or scroll iron or steel, n. e. s	19,838	686,429	23,285	760,514
Nails	21,318	1,391,073	20,927	1,391,343
Iron and steel scrap	64,768	527,211	142,245	1,519,691
Castings and forgings, n. e. s	1,313	232,579	1,482	268,922

MANGANESE AND MANGANIFEROUS ORES

By ROBERT H. RIDGWAY and H. W. DAVIS [1]

SUMMARY OUTLINE

The rise in world output of steel was accompanied by an advance in world production of manganese ore, which attained a new all-time high in 1936. Prices increased during the year, and the market was strong during the closing months. Increases in imports, consumption, domestic production, and prices were noted in the United States. The following table gives the principal statistics of the domestic manganese industry for the past 5 years compared with the annual average for 1925 to 1929, inclusive.

Salient statistics of the manganese industry in the United States, 1925–29 (average) and 1932–36, in long tons

	1925–29 average	1932	1933	1934	1935	1936
Manganese ore:						
Total shipments containing 35 percent or more manganese	59,312	17,777	19,146	26,514	26,428	32,119
Shipments of metallurgical ore	[1] 41,892	9,963	9,527	14,978	16,679	18,557
Shipments of battery ore	17,420	7,012	7,904	8,889	7,264	7,747
Imports for consumption	600,000	90,782	288,187	341,339	383,502	846,648
Stocks in bonded warehouses at end of year	304,000	622,489	490,819	430,714	418,302	366,381
Indicated consumption (35 percent or more manganese)	659,000	110,861	308,971	369,564	413,288	881,777
Ferro-alloys:						
Production of ferromanganese	306,360	56,350	136,267	139,171	214,290	316,000
Imports of ferromanganese [2] [3]	[4] 50,590	14,779	31,759	18,702	21,829	30,593
Production of spiegeleisen	95,463	37,317	26,683	([5])	60,018	95,137
Imports of spiegeleisen [2]	7,298	8,364	26,277	21,184	32,384	52,011
Exports of spiegeleisen and ferromanganese	3,769	33	47	222	131	466
Stocks of ferromanganese in bonded warehouses	[3] [4] 7,765	6,173	6,424	7,124	5,796	9,902

[1] Includes small quantity of miscellaneous ore.
[2] Imports for consumption.
[3] Manganese content.
[4] Includes small quantity of other manganese alloys.
[5] Not at liberty to publish.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

The trend in imports and domestic production of manganese ore from 1900 to 1936 is shown graphically in figure 36.

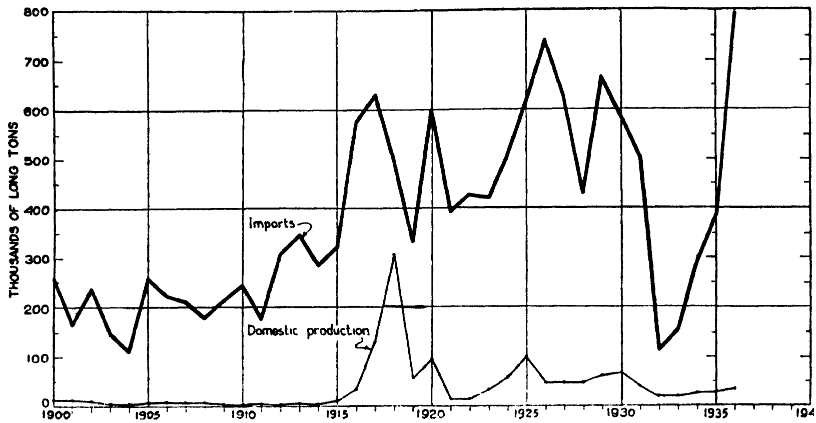


FIGURE 36.—Imports and domestic production of manganese ore, 1900–1936. Statistics on imports shown in the graph represent "general imports" for the period 1900–1933; beginning with 1934 data classified as "general imports" were not available, and the figures plotted for 1934, 1935, and 1936 represent imports for consumption adjusted for changes in stocks in bonded warehouses and are closely comparable with the record for earlier years.

Tariff reductions.—Recent reductions in the tariffs on manganese ore and ferromanganese are given on pages 426, 429, and 434 of Minerals Yearbook, 1936.

Electrolytic manganese.—During 1936 the Bureau of Mines announced the development in the laboratory of a method for producing metallic manganese from its ores by leaching and electrolysis.[3] Further investigations are being made to adapt the process to commercial uses.

DOMESTIC PRODUCTION

The domestic production (shipments from domestic mines) of manganese ore increased 22 percent in 1936 over 1935. The following table shows details of domestic shipments of various grades of manganese ore from 1932 to 1936.

Manganiferous raw materials shipped in the United States, 1932–36, in long tons

Year	Metallurgical ore (ferrous metallurgy only)				Battery ore	Miscellaneous manganese ore
	Manganese ore (35 percent or more manganese)	Ferruginous manganese ore (10 to 35 percent manganese)	Manganiferous iron ore (5 to 10 percent manganese)	Manganiferous zinc residuum		
1932	9,963	15,635	9,799	25,320	7,012	802
1933	9,527	12,779	178,852		7,904	1,715
1934	14,978	23,231	198,591	65,236	8,889	2,647
1935	16,679	93,291	430,893	113,997	7,264	2,485
1936	18,557	98,962	841,557	124,288	7,747	5,815

[3] Shelton, S. M., Electrolysis of Manganese Solutions. Progress Report 13—Metallurgical Division: Rept. of Investigations 3322, Bureau of Mines, 1936, pp. 29–37.

Shipments of the various grades during the last 5 years are given by States in the following tables.[3]

Metallurgical manganese ore shipped from mines in the United States, 1932–36, by States, in long tons

State	1932	1933	1934	1935	1936	State	1932	1933	1934	1935	1936
Alabama	267	806	------	59	377	Tennessee	------	------	------	1,418	2,679
Arkansas	1,306	1,890	5,842	3,809	4,557	Utah	------	------	------	------	1,635
California	------	------	158	306	------	Virginia	------	4,184	1,040	1,972	196
Georgia	200	1,565	6,281	6,960	3,821	West Virginia	------	95	------	------	138
Montana	8,190	987	1,657	2,155	5,154						
							9,963	9,527	14,978	16,679	18,557

Ferruginous manganese ore shipped from mines in the United States, 1932–36, by States, in long tons

State	1932	1933	1934	1935	1936	State	1932	1933	1934	1935	1936
Alabama	4,328	2,810	1,404	647	540	Montana	------	------	11,247	6,818	20,307
Arkansas	208	1,060	1,374	145	3,285	New Mexico	------	------	------	------	170
Colorado	------	------	------	2,625	10,568	Tennessee	------	------	------	------	104
Georgia	9,700	8,505	9,166	3,735	2,717	Utah	------	------	------	190	2,974
Michigan	------	------	------	555	9,627	Virginia	------	404	40	645	874
Minnesota	1,399	------	------	77,931	47,796						
							15,635	12,779	23,231	93,291	98,962

Manganiferous iron ore shipped from mines in the United States, 1932–36, by States, in long tons

State	1932	1933	1934	1935	1936
Alabama	217	685	------	------	------
Colorado	------	------	------	56	------
Georgia	------	------	31	------	427
Michigan	9,582	6,445	595	4,847	------
Minnesota	------	171,722	197,622	419,373	840,725
Wisconsin	------	------	343	6,617	405
	9,799	178,852	198,591	430,893	841,557

Further details by States during 1935 and 1936 are given in the following table.

[3] In addition, battery-grade ores were produced in Montana; manganiferous zinc residuum was produced from New Jersey ores; and miscellaneous ores came from Alabama, Montana, Tennessee, Virginia, and West Virginia.

Manganese and manganiferous ore shipped by mines in the United States, 1935–36, by States

	Ore containing 35 percent or more manganese			Ore containing 10 to 35 percent manganese			Ore containing 5 to 10 percent manganese		
	Shippers	Long tons	Value	Shippers	Long tons	Value	Shippers	Long tons	Value
1935									
Metallurgical:									
Alabama	[1] 1	59	$624	3	647	$6,226			
Arkansas	3	3,809	(2)	1	145	(2)			
California	2	306	(2)						
Colorado				1	2,625	(2)	1	56	(2)
Georgia	4	6,960	95,683	6	3,735	23,722			
Michigan				1	555	1,582	1	4,847	(2)
Minnesota				1	77,931	241,734	2	419,373	$957,624
Montana	1	2,155	(2)	2	6,818	32,077			
Tennessee	[1] 1	1,418	(2)						
Utah				1	190	(2)			
Virginia	[1] 9	1,972	27,241	3	645	4,110			
Wisconsin							1	6,617	(2)
Undistributed			128,742			16,961			38,575
Total metallurgical	21	16,679	252,290	19	93,291	326,412	5	430,893	996,199
Battery: Montana	[1] [3] 2	7,264	254,635						
Total battery	2	7,264	254,635						
Miscellaneous:									
Alabama	[1] 1	126	3,971						
Montana	[1] 2	1,404	37,690						
Tennessee	[1] 2	475							
Virginia	[1] 4	480	8,754						
Total miscellaneous	9	2,485	50,415						
	25	26,428	557,340	19	93,291	326,412	5	430,893	996,199
1936									
Metallurgical:									
Alabama	[4] 1	377	4,015	5	540	5,132			
Arkansas	1	4,557	(2)	1	3,285	(2)			
Colorado				2	10,568	(2)			
Georgia	5	3,821	49,333	12	2,717	11,089	2	427	931
Michigan				1	9,627	29,775			
Minnesota				1	47,796	(2)	4	840,725	1,896,630
Montana	1	5,154	(2)	1	20,307	86,037			
New Mexico				1	170	(2)			
Tennessee	[4] 3	2,679	29,608	1	104	314			
Utah	1	1,635	(2)	5	2,974	19,931			
Virginia	[4] 3	196	2,222	3	874	6,398			
West Virginia	[4] 1	138	2,130						
Wisconsin							1	405	1,807
Undistributed			213,803			177,322			
Total metallurgical	16	18,557	301,111	33	98,962	335,998	7	841,557	1,899,368
Battery: Montana	[3] [4] 2	7,747	312,332						
Total battery	2	7,747	312,332						
Miscellaneous:									
Alabama	[4] 1	195	5,543						
Montana	[4] 2	3,555	57,977						
Tennessee	[4] 3	860							
Virginia	[4] 5	1,165	18,550						
West Virginia	[4] 1	40	887						
Total miscellaneous	12	5,815	82,957						
	23	32,119	696,400	33	98,962	335,998	7	841,557	1,899,368

[1] 1 producer in Alabama, 1 in Tennessee, and 4 in Virginia shipped both metallurgical and miscellaneous ore, and 1 in Montana shipped both battery and miscellaneous ore.
[2] Included under "Undistributed."
[3] Mills through which all ore was shipped; producers not counted.
[4] 1 producer in Alabama, 2 in Tennessee, 2 in Virginia, and 1 in West Virginia shipped both metallurgical and miscellaneous ore, and 1 in Montana shipped both battery and miscellaneous ore.

Alabama.—All shipments of manganese ore from Alabama in 1936 were made by J. B. Bynum, who operates the Walnut Grove mine at Walnut Grove, Etowah County. Shipments of metallurgical-grade ore, which amounted to 377 long tons, averaged (dried) 40.68 percent manganese and 2 percent iron, and ore shipped for miscellaneous uses, which amounted to 195 tons, contained 76.45 percent MnO_2. Shipments of ferruginous manganese ore from Alabama in 1936 totaled 540 tons containing (natural) 30.56 percent manganese; the ore came from Cherokee and Etowah Counties.

Arkansas.—Shipments of manganese from Arkansas in 1936, which totaled 4,557 long tons, came from the Batesville-Cushman district in Independence County and contained (dried) 45.8 percent manganese. In addition, 3,285 tons of ferruginous manganese ore containing (dried) 30 percent manganese were shipped from the same district.

Colorado.—No manganese ore was shipped from Colorado in 1936, but 10,568 long tons of ferruginous manganese ore were shipped from two counties. The Pandora Mines Co., from its operations near Leadville in Lake County, shipped 8,923 tons of ore containing (natural) 17.0 percent manganese and 22.7 percent iron. The Pershing mine near Kerber Creek in Saguache County shipped 1,645 tons containing (natural) 30.4 percent manganese and 8.1 percent iron.

Georgia.—Shipments of manganese ore and ferruginous manganese ore in Georgia in 1936 declined due to the shutting down, during the last 6 months of the year, of the principal producer. Of the 3,821 long tons of manganese ore shipped from Georgia in 1936, all but 60 tons came from the Cartersville district in Bartow County. Although there are several shippers in the district, 3,435 tons containing (natural) 37.72 percent manganese and 7.29 percent iron were shipped by the White Manganese Corporation. The 60 tons shipped from Floyd County came from the Gibson mine near Cedartown and contained (natural) 38 percent manganese.

Shipments of ferruginous manganese ore, which totaled 2,717 tons and contained (natural) 19.14 percent manganese, came from the Cartersville district and from the Gibson mine in Floyd County. In addition, 427 tons of manganiferous iron ore averaging 5.29 percent manganese were shipped from the Cartersville district in 1936. Shipments of untreated iron ore which contained up to 5 percent manganese were also inaugurated during 1936 and are included in the production of iron ore for Georgia. This ore is mined cheaply from small open-cuts and shipped by rail to Birmingham.

Michigan.—The Rogers mine near Iron River in Iron County shipped 9,627 long tons of ore containing (natural) 10.52 percent manganese and 41.34 percent iron, which comprised the total output for Michigan in 1936.

Minnesota.—All shipments of manganese-bearing ores came from the Cuyuna range in Crow Wing County. Shipments of ferruginous manganese ores, which came from the Merritt mine near Trommald, totaled 47,796 long tons containing (natural) 10.85 percent manganese and 33.88 percent iron. Shipments of manganiferous iron ore (840,725 tons) came from four properties (Alstead-Hillcrest, Louise, Sagamore, and Mahnomen) and averaged 7.87 percent manganese and 36 percent iron.

Montana.—Shipments of manganese ore in Montana in 1936 increased 52 percent over 1935. Forty-seven percent of the output was battery-grade ore from the Philipsburg district, and 31 percent was

metallurgical-grade ore, which comprised sintered rhodochrosite and contained 63.59 percent manganese. Shipments for miscellaneous uses accounted for the remainder of the output and contained (natural) 41.4 percent manganese. Shipments of ferruginous manganese ore containing (natural) 19.6 percent manganese were tailings from the battery-ore concentrating mills in the Philipsburg district and amounted to 20,307 long tons.

New Mexico.—Shipments were made from New Mexico in 1936 for the first time in several years. The output came from Sierra County and totaled 170 long tons of ore containing (natural) 34.6 percent manganese and 9.0 percent iron.

Tennessee.—The bulk of the metallurgical ore shipped from Tennessee in 1936, which amounted to 2,679 long tons, came from the operations of the Embree Iron Co. at Embreeville in Unicoi County and averaged (natural) 35.61 percent manganese and 9.49 percent iron. Shipments of ores for miscellaneous purposes came from scattered, small operations in the northeastern counties and totaled 860 tons.

Utah.—Relatively large increases were noted in shipments of manganese-bearing ores in Utah in 1936. Millard and Juab Counties furnished 1,635 long tons of ore which contained (natural) 35.7 percent manganese and 9.4 percent iron. No shipments of this grade were reported in 1935. In addition, shipments of 2,974 tons of ferruginous manganese ore averaging (natural) 30 percent manganese were reported in 1936, compared with 190 tons in 1935.

Virginia.—Shipments of manganese ore from Virginia in 1936 were 1,361 long tons—1,165 tons of miscellaneous ore, containing (natural) 43.09 percent manganese, and 196 tons of metallurgical ore, containing 37.24 percent manganese. The bulk of the total came from Bland County, but shipments were also reported from Giles, Page, and Shenandoah Counties. The old Capola Mountain mine near Woodstock in Shenandoah County was reopened during the year, and a small mill was built and put in operation. Shipments of ferruginous manganese ore, which came from Bland and Giles Counties in 1936, were 874 tons, containing (natural) 25.29 percent manganese compared with 645 tons in 1935.

West Virginia.—Shipments of manganese ore from West Virginia, the first since 1933, totaled 178 long tons, of which 138 tons were metallurgical ore containing (natural) 44.3 percent manganese and 2.2 percent iron and 40 tons were ores for miscellaneous uses containing 69.2 percent manganese dioxide. The entire output came from the Monroe Manganese Mining Corporation Sweet Springs mine near Sweet Springs in Monroe County.

Wisconsin.—Wisconsin shipped 405 long tons of manganiferous iron ore in 1936 which contained (natural) 7.25 percent manganese and 46.75 percent iron. All shipments came from the Cary mine in Iron County.

Puerto Rico.—Shipments of manganese ore from Puerto Rico were 3,010 long tons in 1936 compared with 3,358 tons in 1935. The entire output of the island comes from the mine of the Atlantic Ore Co. about 3 miles from Juana Diaz.

IMPORTS OF MANGANESE ORE

Imports of manganese ore for consumption in the United States in 1936 increased 121 percent over 1935 and were probably the largest on record. Of the 1936 total the U. S. S. R. (Russia) supplied 34 percent.

Manganese ore imported into the United States, 1934–36, by countries

Country	Manganese ore (long tons)			Manganese content (long tons)			Value		
	1934	1935	1936	1934	1935	1936	1934	1935	1936
Brazil	55,834	29,528	110,018	24,483	13,484	52,265	$418,342	$205,571	$872,371
British West Africa, other			3			1			26
Canada	1,520	917	2,435	840	471	1,159	32,442	29,302	32,380
Chile	1,133	3,442	3,828	567	1,702	1,848	7,103	28,367	36,259
Cuba	63,743	43,955	37,912	31,431	22,220	17,472	965,610	700,493	521,809
Czechoslovakia		3	6		2	3		1,124	1,729
Egypt	50		33,247	28		9,925	2,452		107,362
France	(1)	3	59	(1)	1	29	9	521	11,975
Germany	17	158	113	9	82	55	1,334	14,650	29,870
Gold Coast	73,656	95,134	241,594	36,913	48,916	125,893	982,953	1,285,483	3,166,498
Hong Kong			1			1			55
India (British)	20,550	56,595	126,913	10,493	28,890	65,699	216,381	604,983	1,307,436
Netherland East Indies		29	552		16	279		1,189	14,082
Philippine Islands		500			240			6,500	
Union of South Africa			100			50			1,347
U. S. S. R. (Russia)	124,836	153,200	289,867	61,076	73,213	141,070	902,556	1,327,876	2,716,401
United Kingdom		38			21			2,710	
	341,339	383,502	846,648	165,840	189,258	415,749	3,529,182	4,208,769	8,819,600

[1] Less than 1 ton.

Stocks.—For the fourth consecutive year stocks of manganese ore in bonded warehouses declined, and at the end of 1936 amounted to 366,381 long tons, containing 181,685 tons of manganese metal. The figure for 1936 is the lowest reported since 1929.

Prices.—Prices of manganese ore according to grade and origin, as quoted by the various trade journals, are for imported ore and (except for battery ore) are on a unit basis. The unit is 1 percent of 1 long ton (22.4 pounds of metallic manganese). Prices of battery-grade ore are quoted on a per-ton basis, with a minimum requirement of manganese dioxide.

The prices in the following table are quoted from the Engineering and Mining Journal:

Domestic prices of metallurgical manganese ore, 1936, in cents per long-ton unit

[C. i. f. North Atlantic ports, cargo lots, exclusive of duty]

	Beginning of year	End of year		Beginning of year	End of year
Brazilian, 46–48 percent manganese	$0.24	$0.25	Caucasian, 52–55 percent manganese	$0.26	$0.30
Chilean, 47 percent manganese	.25	.26	South African:		
Indian, 48–50 percent manganese	.25	.30	49–51 percent manganese	.26	.30
			44–48 percent manganese	.24	.25

According to the Engineering and Mining Journal the prices for chemical (battery) ores during 1936 were as follows: Domestic chemical ores containing 70 to 72 percent manganese dioxide, $40 to $45 a ton in carload lots and imported chemical ores containing 80 to 85 percent manganese dioxide, $45 to $60 throughout 1936.

CONSUMPTION OF MANGANIFEROUS RAW MATERIALS

The following table shows the indicated consumption of manganiferous raw materials in the United States in 1935 and 1936. The table does not consider differences in consumers' stocks at the beginning and end of the year. As such stocks are largely imported ore and the import figure used in the table is that for "imports for consumption" it is thought that the change in stocks would not be great because the manganese ore may be kept in bond until withdrawn for consumption. The duty is then paid, and the ore is reported as imports for consumption.

Indicated consumption of manganiferous raw materials in the United States, 1935–36

	Ore containing 35 percent or more manganese		Ore and residuum containing 10 to 35 percent manganese		Ore containing 5 to 10 percent manganese	
	Long tons	Manganese content (percent)	Long tons	Manganese content (percent)	Long tons	Manganese content (percent)
1935						
Domestic shipments	[1] 29,786	[2] 45	207,288	14	430,893	7.4
Imports for consumption	383,502	49	[3] 1,927	21	[3] 86,815	7.4
Total available for consumption	413,288	49	209,215	14	517,708	7.4
1936						
Domestic shipments	[1] 35,129	[2] 46	223,250	14	841,557	7.9
Imports for consumption	846,648	49	[3] 40,389	27	[3] 103,079	6.2
Total available for consumption	881,777	49	263,639	16	944,636	7.7

[1] Includes shipments from Puerto Rico. [2] Partly estimated. [3] Estimated.

Besides the material shown in the foregoing table, 825,272 long tons of iron ore containing 2 to 5 percent manganese presumably were used in the manufacture of manganiferous pig iron in 1936 compared with 575,402 tons in 1935. Figures for imports of this class of ore are not available.

METALLURGICAL INDUSTRY

Although manganese ore is used in both the ferrous and nonferrous metallurgical industries, the bulk is consumed in the manufacture of iron and steel. Most of the ore entering this industry is used in the manufacture of ferromanganese and spiegeleisen, the forms in which manganese usually is added to steel.

Chief manganese alloys imported into and made from domestic and imported ores in the United States, 1935–36, in long tons

	1935		1936	
	Alloy	Manganese	Alloy	Manganese
Ferromanganese:				
Imported	27, 240	21, 829	37, 953	30, 593
Domestic production	214, 290	170, 168	316, 000	249, 933
From domestic ore [1]	1, 916	1, 532	2, 506	1, 812
From imported ore [1]	212, 374	168, 636	313, 494	248, 121
Total	241, 530	191, 997	353, 953	280, 526
Ratio (percent) of manganese in ferromanganese of domestic origin to total manganese in ferromanganese made and imported		0. 80		0. 65
Number of plants making ferromanganese	7		8	
Spiegeleisen:				
Imported	32, 384	[1] 6, 477	52, 011	[1] 10, 402
Domestic production	60, 018	12, 310	95, 137	19, 568
From domestic ore [1]	41, 215	8, 487	52, 379	10, 861
From imported ore [1]	18, 803	3, 823	42, 758	8, 707
Total	92, 402	18, 787	147, 148	29, 970
Ratio (percent) of manganese in spiegeleisen of domestic origin to total manganese in spiegeleisen made and imported		45. 17		36. 24
Number of plants making spiegeleisen	4		6	
Total available supply of metallic manganese as alloys		210, 784		310, 496
Percent of available supply of manganese in—				
Ferromanganese and spiegeleisen imported		13. 43		13. 20
Ferromanganese made from imported ore		80. 01		79. 91
Spiegeleisen made from imported ore		1. 81		2. 81
Ferromanganese made from domestic ore		. 73		. 58
Spiegeleisen made from domestic ore		4. 02		3. 50
Ferromanganese and spiegeleisen made from domestic ore		4. 75		4. 08
Spiegeleisen made and imported		8. 91		9. 65
Total open-hearth and Bessemer steel	33, 550, 460		46, 994, 585	

[1] Estimated.

Ferromanganese.—In 1936 the following plants produced the domestic output, which increased 47 percent over that in 1935:

Pittsburgh Metallurgical Co., Niagara Falls, N. Y.
Bethlehem Steel Co., Johnstown, Pa.
Jones & Laughlin Steel Corporation, Aliquippa, Pa.
Lavino Furance Co., Reusens, Va.
Tennessee Coal, Iron & Railroad Co, Ensley, Ala.
Carnegie-Illinois Steel Corporation, North Braddock and Etna, Pa.
Electro Metallurigcal Co., Alloy, W. Va.

In addition to the above plants, the Lavino Furnace Co., Sheridan, Pa., made shipments from stock.

Domestic production of ferromanganese during the last 5 years and metalliferous materials consumed in its manufacture are shown in the following table:

Ferromanganese produced in the United States and metalliferous materials consumed in its manufacture, 1932–36

Year	Ferromanganese produced			Materials consumed (long tons)				Manganese ore used per ton of ferromanganese made (long tons)
	Long tons	Manganese contained		Manganese ore		Iron and manganiferous iron ores	Cinder, scale, and purchased scrap	
		Percent	Long tons	Foreign	Domestic			
1932	56, 350	77. 66	43, 760	90, 677	10, 666	5, 270	1, 499	1. 798
1933	136, 267	79. 30	108, 059	233, 607	10, 695	10, 795	1, 655	1. 793
1934	139, 171	78. 67	109, 491	256, 980	853	13, 933	3, 304	1. 853
1935	214, 290	79. 41	170, 168	401, 846	4, 286	9, 195	8, 921	1. 895
1936	316, 000	79. 09	249, 933	595, 114	5, 987	12, 467	2, 821	1. 902

The following table lists the source of the foreign manganese ore used in the manufacture of ferromanganese from 1932 to 1936.

Foreign manganese ore used in manufacture of ferromanganese in the United States, 1932–36, in long tons

Source of ore	1932	1933	1934	1935	1936
Africa	5, 135	30, 427	46, 096	69, 857	199, 143
Brazil	25, 279	42, 805	55, 778	47, 663	86, 032
Chile		1, 046	451	2, 941	832
Cuba	2, 126	28, 275	16, 242	56, 411	32, 317
India	11, 541	22, 499	21, 460	76, 983	105, 289
Philippine Islands				520	
U. S. S. R. (Russia)	46, 596	108, 555	116, 953	147, 471	171, 501
	90, 677	233, 607	256, 980	401, 846	595, 114

Shipments of ferromanganese in 1936 increased 66 percent over 1935. The trend of shipments during the last 5 years has been as follows:

Ferromanganese shipped from furnaces in the United States, 1932–36

Year	Long tons	Value	Year	Long tons	Value
1932	70, 417	$5, 061, 029	1935	194, 627	$16, 374, 328
1933	127, 453	9, 384, 611	1936	322, 353	24, 088, 298
1934	147, 947	12, 345, 697			

Although there is a slight export trade in ferromanganese, the quantity manufactured in the United States is supplemented by imports. Ferromanganese imported for consumption in 1936 included 532 long tons containing not over 1 percent carbon; virtually all of it came from Norway.

Ferromanganese imported into and exported from the United States, 1932–36

Year	Imports for consumption			Exports [1]	
	Gross weight (long tons)	Manganese content (long tons)	Value	Gross weight (long tons)	Value
1932	18, 470	14, 779	$1, 091, 026	33	$2, 369
1933	39, 693	31, 759	2, 548, 068	47	3, 393
1934	23, 349	18, 702	1, 441, 360	222	12, 580
1935	27, 240	21, 829	1, 731, 411	131	10, 389
1936	37, 953	30, 593	2, 251, 951	466	26, 540

[1] Include spiegeleisen; not separately classified.

Norway furnished 68 percent of the imports in 1936. The following table indicates the distribution of imports by countries for 1935 and 1936.

Ferromanganese imported for consumption in the United States, 1935–36, by countries

Country	1935		1936	
	Manganese content (long tons)	Value	Manganese content (long tons)	Value
Canada	40	$4,500	1	$66
Czechoslovakia			557	30,609
France	2,091	193,006	2,151	204,184
Germany	1,025	64,694	21	2,467
Italy	709	97,523	126	16,222
Japan			257	31,155
Netherlands	1,095	61,166	4,346	261,748
Norway	14,365	1,156,488	20,655	1,569,844
Poland and Danzig	157	9,889	1,997	108,346
Sweden			4	673
United Kingdom	2,347	144,145	478	26,637
	21,829	1,731,411	30,593	2,251,951

Ports into which imported ferromanganese entered in 1935 and 1936 were as follows:

Manganese content of ferromanganese imported for consumption in the United States, 1935–36, by ports of entry, in long tons

Port of entry	1935	1936	Port of entry	1935	1936
Buffalo	1,417	1,388	New York	1,509	1,737
Chicago	594	2,980	Oregon	20	
Connecticut		118	Philadelphia	1,347	3,344
Galveston	19	23	Pittsburgh	20	51
Los Angeles	304	97	Rhode Island		79
Maryland	14,122	16,571	San Francisco	363	247
Massachusetts	120	125	Virginia		39
Mobile		720	Washington (State)	253	391
New Orleans	1,741	2,683			
				21,829	30,593

Stocks of ferromanganese in bonded warehouses at the end of 1936 amounted to 9,902 long tons containing 8,177 tons of manganese metal.

The price of ferromanganese, which dropped $10 and reached $80.13 per long ton in January as a result of the lower tariff under the trade agreement with Canada, was increased $5.00 per ton in November.

Prices per long ton of ferromanganese in the United States, 1934–36 [1]

[80 percent—delivered at Pittsburgh]

Month	1934	1935	1936	Month	1934	1935	1936
January	$90.24	$89.79	$90.13	July	$89.79	$90.13	$80.13
February	90.24	89.79	80.13	August	89.79	90.13	80.13
March	90.24	89.79	80.13	September	89.79	90.13	80.13
April	90.24	89.85	80.13	October	89.79	90.13	80.13
May	90.24	90.13	80.13	November	89.79	90.13	80.13
June	90.00	90.13	80.13	December	89.79	90.13	85.13

[1] Steel, vol. 100, Jan. 4, 1937.

Spiegeleisen.—Production and shipments of spiegeleisen increased 59 and 69 percent, respectively, in 1936 as shown in the following table.

Spiegeleisen produced and shipped in the United States, 1932–36

Year	Produced (long tons)	Shipped from furnaces		Year	Produced (long tons)	Shipped from furnaces	
		Long tons	Value			Long tons	Value
1932	37,317	31,071	$745,966	1935	60,018	54,793	$1,303,574
1933	26,683	50,218	1,144,642	1936	95,137	92,336	2,249,217
1934	(1)	45,769	1,099,922				

[1] Not at liberty to publish.

Spiegeleisen was manufactured at the following plants in 1936:

New Jersey Zinc Co., Palmerton, Pa.
Lavino Furnace Co., Reusens, Va.
Tennessee Coal, Iron & Railroad Co., Ensley, Ala.
Carnegie-Illinois Steel Corporation, North Braddock and Etna, Pa.
Keokuk Electro-Metals Co., Keokuk, Iowa.

Most of the spiegeleisen produced in the United States is made from domestic raw materials, but 31,159 long tons of ferruginous manganese ore were consumed in the manufacture of spiegeleisen in 1936.

Imports of spiegeleisen for consumption increased 61 percent in 1936 over 1935. Canada, with 46,051 tons, furnished 89 percent of the total in 1936. The remainder came from Norway and the U. S. S. R. (Russia).

Spiegeleisen imported for consumption in the United States, 1932–36

Year	Long tons	Value	Year	Long tons	Value
1932	8,364	$192,037	1935	32,384	$915,134
1933	26,277	640,613	1936	52,011	1,404,983
1934	21,184	595,017			

The price of spiegeleisen containing 20 percent manganese at producers' furnaces has been quoted by trade journals at $26 per ton for 1934, 1935, and 1936.

Manganiferous pig iron.—Precise data on the consumption of manganiferous ores in the production of manganiferous pig iron are not available; however, 841,557 long tons of domestic ore containing 5 to 10 percent manganese and 825,272 tons containing 2 to 5 percent manganese were shipped in 1936. Foreign manganiferous iron ore (103,079 tons) also was consumed in the manufacture of pig iron. The sources of the foreign ores for the last 3 years are named in the following table. Import figures on ore containing 2 to 5 percent manganese are not available.

Foreign ferruginous manganese ore and manganiferous iron ore consumed in the United States, 1934–36, in long tons

Source of ore	Ferruginous manganese ore			Manganiferous iron ore		
	1934	1935	1936	1934	1935	1936
Africa				9,836	2,912	3,737
Australia	263		9,127	54,390	66,879	94,818
Brazil	351	97				
Canada		1,830				
Cuba			103			
Spain				32,888	9,638	
Sweden				7,473	7,386	4,524
Undistributed			31,159			
Total	614	1,927	40,389	104,587	86,815	103,079

BATTERY INDUSTRY

Shipments of manganese ore by domestic producers to battery makers in 1936 totaled 7,747 long tons and shipments from Puerto Rico 3,010 tons, indicating a consumption of 10,757 tons of domestic materials in battery manufacture. Imported manganese ore also was consumed in the battery industry, but no figures are available for such imports.

MISCELLANEOUS INDUSTRIES

Manganese ore is also consumed in the chemical, ceramic, and glass industries. Certain ores with peculiar physical or chemical properties are required for the manufacture of special articles in these industries.

WORLD PRODUCTION

The following table shows, insofar as statistics are available, the world production of manganese ores from 1932 to 1936 and their average manganese content. Most of the figures are from official statistics of the countries concerned, supplemented by data from semiofficial and other sources.

Manganese ore produced in the principal countries, 1932–37, in metric tons

[Compiled by R. B. Miller]

Country [1]	Percentage of manganese	1932	1933	1934	1935	1936
North America:						
Canada (shipments)						200
Cuba	36–50+	9,800	28,000	68,000	35,269	48,085
Mexico	40+	[2] 700	573	664	3,217	3,337
United States:						
Continental (exclusive of fluxing ore)	35+	18,062	19,453	26,940	26,852	32,635
Puerto Rico [3]	48–51	2,339	1,664	1,738	3,412	3,058
South America:						
Argentina [4]	40–42	252	410	583	[2] 500	([5])
Brazil	38–50	20,300	25,000	7,527	41,767	156,201
Chile [3]	40–50	448	765	4,065	4,370	([5])
Europe:						
Germany	30+	12	563	515	224	([5])
Greece	30+	745	1,628	[3] 1,800	[3] 436	([5])
Hungary	35–48	1,497	6,232	10	6,291	27,228
Italy	34–37	378	4,524	6,941	9,127	([5])
Portugal	40+		26	295	158	284
Rumania	30–36	5,051	2,774	12,057	19,653	([5])

See footnotes at end of table.

Manganese ore produced in the principal countries, 1932-37, in metric tons—Continued

Country	Percentage of manganese	1932	1933	1934	1935	1936
Spain	31-34	2,591	2,834	3,796	1,280	(5)
Sweden	30-50	3,014	5,895	5,832	6,495	(5)
U. S. S. R. (Russia)	41-48	832,100	1,021,300	1,821,000	2,384,600	[2] 2,700,000
Yugoslavia	32-38	160	535	1,103	928	2,739
Asia:						
China [3]	45-46	20,733	9,574	870	827	23,794
India:						
British	47-52	216,016	221,311	412,827	651,779	(5)
Portuguese	42-50+	3,573	1,600	3,800	4,100	(5)
Indochina					1,600	(5)
Japan	49-51	26,242	43,535	57,165	71,659	(5)
Netherland (East Indies)	50-55	8,287	10,463	11,635	12,338	(5)
Philippine Islands	45-50				508	(5)
Turkey	30-50	2,800	7,700	2,687	15,600	5,200
Africa:						
Egypt	30+	327	187	959	87,303	(5)
Gold Coast [4]	50+	51,502	269,395	344,832	405,117	(5)
Morocco (French)	40-50+	3,980	4,800	3,407	24,892	38,400
Northern Rhodesia	30-48		5,453	2,074	4,040	3,071
Union of South Africa	48-51		21,229	57,730	95,450	258,243
Oceania:						
Australia:						
New South Wales		108	131	105	150	(5)
South Australia		20	2	2		(5)
		1,231,000	1,718,000	2,861,000	3,920,000	(5)

[1] In addition to the countries listed Belgium is reported to produce a small quantity of manganese ore, but statistics of output are not available. Czechoslovakia reports a production of "manganese ore", but as it has been ascertained that the product so reported averages less than 30 percent manganese and therefore would be considered ferruginous manganese ore under the classification used in this report the output has not been included in the table.
[2] Approximate production.
[3] Exports.
[4] Shipments by rail and river.
[5] Data not available.

Brazil.—Exports from Brazil in 1936 were 166,471 metric tons, a large increase over the 60,669 tons exported in 1935. Production was 156,201 tons in 1936.

Cuba.—Output by the Cuban-American Manganese Corporation, the principal producer, amounted to 48,085 metric tons of sintered and unsintered concentrates in 1936; exports from Santiago were 34,813 tons. During 1935 and 1936 this company conducted extensive research and experimental work in an effort to reduce production costs. Changes in operating methods required new machinery, which is being installed, and plans have been made to resume operations early in 1937.

Egypt.—Production of manganese ores in Egypt increased in 1936. Two companies, the Sinai Mining Co. with operations near Abu Zenima and the Hamata Mining Co. near Hamata, furnished the total output.

Gold Coast.—The African Manganese Mines Co. Ltd., which operates at Nsuta, near Tarkwa, Wasaw district, Western Province, is the only producer of manganese ore in Gold Coast Colony. Exports were about 400,000 metric tons in 1936. During the year a Dwight Lloyd plant for sintering part of the ore was erected and put into operation.

British India.—Waterborne exports from India, normally the second largest producer in the world, dropped from 713,557 metric tons in 1935 to 644,197 tons in 1936. These figures do not include exports through Mormugao, which were 165,017 tons in 1935.

Union of South Africa.—Production of manganese ore in the Union of South Africa in 1936 rose to 258,243 metric tons compared with 95,450 tons in 1935. The producing deposits are north of Postmasburg in Griqualand West. The principal producers are the Associated Manganese Mines of S. A., Ltd., and the South African Manganese, Ltd. In May 1936 the railway line was extended from Postmasburg to the Gloucester deposits to permit all-rail haul to Durban, where there are adequate port facilities. Exports during 1936 were 207,841 tons.

U. S. S. R. (Russia).—Output of manganese ore in the U. S. S. R. established a new record in 1936; various estimates place the production between 2,700,000 and 3,000,000 metric tons. The exhaustion of the more easily minable ore at Chiaturi, the principal producing district, has necessitated considerable reconstruction and installation of new equipment for the development of underground mining. The Nikopol mines in the Ukraine, which are becoming more important and at present produce nearly as much as the Chiaturi mines, have been improved by the sinking of new shafts and the installation of electric haulage. Relatively small, but increasing, amounts of manganese ore are coming from the Mazulka mines in West Siberia, where reserves are estimated at 10,000,000 tons. Exports from the U. S. S. R. in 1936 were 605,733 tons compared with 644,874 tons in 1935.

CHROMITE

By Robert H. Ridgway

SUMMARY OUTLINE

World production of chromite is consumed principally in the ferrous-metallurgical industry. Active postdepression demands for steel, coupled with accelerated armament activities by the military powers, increased the demand for chromite in 1936. Higher prices, particularly for metallurgical grades, reflected the greater demand, which according to trade reports resulted in a scarcity of first-grade ores available for spot buyers at the end of the year. World production in 1935 established a new all-time peak of 794,000 metric tons. Swelled by large increases in output in Southern Rhodesia and the Union of South Africa, world production in 1936 increased to a new record, although complete production figures are not yet available.

The following table compares salient statistics of the chromite industry in the United States during the last 5 years with the yearly average from 1925 to 1929.

Salient statistics of the chromite industry in the United States, 1925–29 (average) and 1932–36

	1925–29 average	1932	1933	1934	1935	1936
Production ... long tons	262	200	966	341	440	269
Apparent available supply:						
Imports ... do	224,357	89,143	116,511	192,297	259,063	324,258
Shipments from domestic mines ... do	276	155	843	369	515	269
	224,633	89,298	117,354	192,666	259,578	324,527
Price per long ton at New York, approximate average of all grades	$22.46	$18.50	$17.00	$19.00	$17.70	$17.76
Imports:						
Africa [1] ... percent of total	63	20	11	26	36	37
Cuba ... do	15		21	26	18	22
Greece ... do	9	18	10	12	8	8
New Caledonia ... do	6	13	13	10	22	20
Turkey ... do		20	24	15	6	6
U. S. S. R. (Russia) ... do		5	11	10	1	1
Other countries ... do	7	24	10	1	9	6
World production ... long tons	428,000	294,000	403,000	607,000	781,000	(2)

[1] Originated in Southern Rhodesia and Union of South Africa.
[2] Figures not yet available.

Figure 37 shows the trend of domestic consumption and prices during the past 12 years.

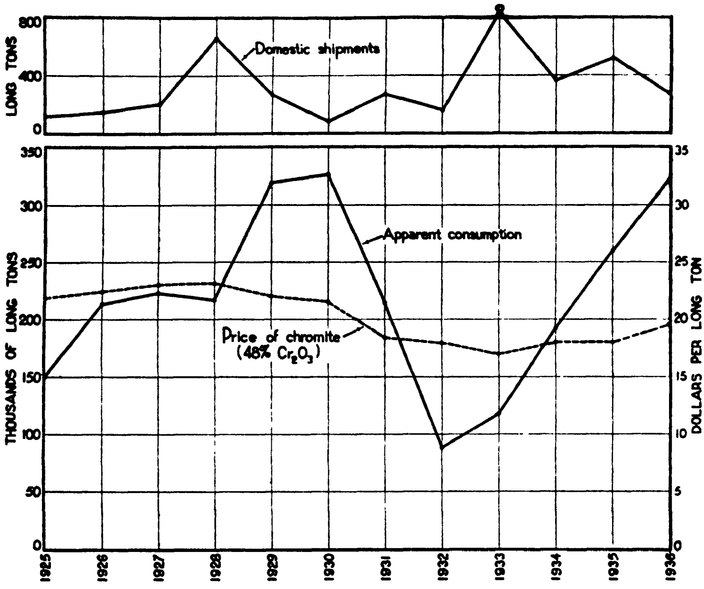


FIGURE 37.—Trends in consumption, price, and domestic shipments of chromite in the United States, 1925–36.

DOMESTIC PRODUCTION

The following table shows the production and shipments of chromite in the United States from 1932 to 1936. Shipments in 1936 were reported from Del Norte, Eldorado, Fresno, Napa, San Luis Obispo, and Santa Barbara Counties in California.

Crude chromite mined and shipped from mines in the United States (all from California), 1932–36

Year	Ore containing 45 percent of more chromic oxide			Ore containing 35 to 45 percent chromic oxide			Total value
	Mined (long tons)	Shipped		Mined (long tons)	Shipped		
		Long tons	Value		Long tons	Value	
1932	200	155	$2,160	----------	----------	----------	$2,160
1933	879	743	(1)	87	100	(1)	11,585
1934	331	320	(1)	[2] 10	49	(1)	4,653
1935	66	74	(1)	[3] 374	[3] 441	(1)	[3] 6,163
1936	(4)	(4)	(4)	[4] 269	[4] 269	[4] $2,978	[4] 2,978

[1] Included in total value; Bureau of Mines not at liberty to publish figures separately.
[2] Produced in Montana but not shipped.
[3] Includes 52 tons containing less than 35 percent Cr_2O_3.
[4] A small quality of ore produced and shipped in 1936, containing more than 45 percent Cr_2O_3, may not be shown separately and is included under ore containing 35 to 45 percent Cr_2O_3.

Although all production and shipments in 1936 came from California there was considerable exploration for chromite in Oregon, Montana,

and Washington.[1] Preliminary studies on the treatment of domestic chrome ores were made by the United States Bureau of Mines during 1936.[2]

IMPORTS [3]

Imports of chromite into the United States totaled 324,258 long tons in 1936 compared with 259,063 tons in 1935, an increase of 25 percent. The chromite imported into the United States in 1936 had a chromic oxide content of 43.5 percent. Of the larger imports in 1936, those from New Caledonia had the highest content of chromic oxide (51 percent), while those from Cuba had the lowest (33 percent).

South Africa (Union of South Africa and Southern Rhodesia) was the principal source of our imports in 1936, contributing 37 percent of the total, while Cuba was second with 22 percent. Although Mozambique is listed by the Bureau of Foreign and Domestic Commerce as the principal source of American imports, the ore from this source originates in Southern Rhodesia and the Union of South Africa. The Southern Rhodesian ore moves out of Beira and the South African ore out of Lourenço Marques. According to the United States Shipping Board, Department of Commerce, imports in 1935 from these ports were as follows:

	Long tons
Beira (Rhodesian ore)	42, 150
Lourenço Marques (Union ore)	29, 515
Total Mozambique	71, 665

The following table shows imports of chromite into the United States, by countries, from 1932 to 1936.

Crude chromite imported into the United States, 1932–36, by countries

Country	1932 (long tons)	1933 (long tons)	1934 (long tons)	1935 (long tons)	1936		
					Long tons		Value
					Gross weight	Chromic oxide content	
Africa [1]	17, 702	13, 186	48, 848	92, 682	120, 011	54, 179	$2, 007, 383
Brazil				2			
Canada		49	30	2, 888	41	15	247
Cuba		23, 772	49, 370	47, 743	69, 963	22, 813	358, 241
Greece	16, 395	11. 499	23, 301	20, 692	26, 688	10, 879	254, 627
Guatemala		2, 061	792				
India (British)	7, 857	4, 152	400	14, 926	14, 795	6, 953	157, 526
Netherlands			259				
New Caledonia	11, 550	15, 150	19, 530	55, 686	65, 450	33, 347	1, 168, 192
"Other" Asia			1, 100				
Philippine Islands				787	4, 986	2, 504	81, 668
Turkey	17, 602	27, 854	28, 730	16, 060	19, 490	9, 186	364, 668
U. S. S. R. (Russia)	4, 800	13, 261	19, 937	3, 412	2, 310	1, 070	37, 310
United Kingdom	13, 237			4, 185			
Yugoslavia		5, 527			524	252	7, 036
	89, 143	116, 511	192, 297	259, 063	324, 258	141, 198	4, 431, 898

[1] Originated in Southern Rhodesia and Union of South Africa; recorded by Foreign and Domestic Commerce as imported from Union of South Africa, Other British South Africa, Mozambique, Other Portuguese South Africa, and Algeria and Tunisia.

[1] Division of Mines and Mining, Department of Conservation and Development, State of Washington, Reported Chromite Deposits in the State of Washington: 1935–36, pp. 1–13.

[2] Koster, J. Studies on the Treatment of Domestic Chrome Ores; Progress Reports, Metallurgical Division, No. 13, Electrometallurgical Studies: Rept. of Investigations 3322, Bureau of Mines, 1936, pp. 3–27. Davis, C. W., and staff of ore-testing section, Report of Tests; Progress Reports—Metallurgical Division, No. 16 Ore-Testing Studies: Rept. of Investigations 3328, Bureau of Mines, 1937, pp. 52–56.

[3] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

The following tables list the imports of chromium alloys and compounds into the United States from 1932 to 1936.

Ferrochrome or ferrochromium and chrome or chromium metal imported for consumption in the United States, 1932–36, in long tons

Class	1932	1933	1934	1935	1936
Ferrochrome or ferrochromium—					
Containing 3 percent or more carbon (chromium content)					4
Containing less than 3 percent carbon (gross weight)	159	168	110	30	66
Chrome or chromium metal	20	43	16	49	57

Chromium compounds imported for consumption in the United States, 1932–36

Year	Chromic acid		Chromate and bichromate of potash		Chromate and bichromate of soda	
	Pounds	Value	Pounds	Value	Pounds	Value
1932	2,020	$534	786	$172	246	$65
1933	2,040	629	1,892	417		
1934	2,149	1,011	22	5	110	32
1935	4,281	2,198				
1936	2,685	1,225	1,653	469	909	198

CONSUMPTION

Owing to lack of data concerning consumers' stocks, it is impossible to estimate accurately the actual consumption of chromite in the United States. However, the apparent available supply increased from 259,578 long tons in 1935 to 324,527 tons in 1936 and was greater than in any year since 1930.

The increase in consumption of chromite during 1936 reflects increased activity in the steel industry, the principal consumer. The domestic automobile industry, one of the principal users of alloy steels and chromium plating, increased its output 13 percent over 1935, making 4,454,535 cars in 1936 or the largest number since 1929. The building-construction industry uses stainless steel for decorative purposes and large quantities of chromium-plated plumbing fixtures. Activity in this field improved materially over that in 1935.

The following table shows the apparent available supply of chromite in the United States from 1932 to 1936.

Domestic sales, imports, and apparent available supply of crude chromite in the United States, 1932–36, in long tons

Year	Sales from domestic mines	Imports	Apparent available supply	Year	Sales from domestic mines	Imports	Apparent available supply
1932	155	89,143	89,298	1935	515	259,063	259,578
1933	843	116,511	117,354	1936	269	324,258	324,527
1934	369	192,297	192,666				

USES

Industrial uses of chromite fall into three groups, which are in order of importance: Metallurgical, refractory, and chemical. Increasing quantities are being absorbed in chemical uses.

METALLURGICAL

Alloy steels.—Chromium is one of the principal elements used in the manufacture of alloy steels. For this purpose most of the chromite is converted to ferrochromium in the electric furnace before it is added to the steel bath, although one domestic concern makes chromium alloy steels in the electric furnace directly from alloy-steel scrap, mild-steel scrap, and chromite. Lippert[4] has described a method of making stainless-steel castings by the reduction of chromite in a hollow-electrode furnace.

Steady advance in the field of alloy steels and irons has broadened their market and thus increased consumption of chromite. Steel[5] has listed 300 concerns supplying alloys and alloy steels for industrial uses. Chromium in varying quantities, either alone or combined with other alloying elements (including aluminum, columbium, copper, manganese, molybdenum, nickel, nitrogen, selenium, silicon, sulphur, titanium, tungsten, vanadium, and zirconium), enters into the manufacture of a wide variety of alloy steels designed for special purposes. Although figures for the production of stainless iron and steel are not available, it has been estimated[6] that the tonnage in 1936 was double that in 1935. Twelve-car streamline railroad trains constructed of stainless steel were in operation in 1936. A new alloy containing 35 percent chromium and 7 percent aluminum is said to be suitable for continuous service at 2,300° F. Most of the corrosion- and heat-resisting steels manufactured in the past were covered by the Strauss or Haynes patents, which either expired in 1936 or will expire in 1937. Although these are the basic patents, others will exert a definite influence in this field.

Of interest during 1936 was the continued development of low-alloy, high-tensile steels. These steels have been divided[7] into three general types: Chromium steels, nickel steels, and manganese steels. Of the several types of chromium steels, the two best known in the United States are those containing 0.50 and 1 percent chromium.

Chromium plating.—In recent years[8] chromium plating has had a wide field of uses and has become important industrially, but the amount of raw material consumed is small owing to the thinness of the layer of metal deposited.

In a decision of the United States Circuit Court of Appeals for the Second District, dated September 21, 1936, the court found that patent 1581188 was invalid.

---

4 Lippert, T. W., Arc-Refined Stainless Steel Castings: Iron Age, vol. 139, no. 4, 1937, pp. 18-23.

5 Steel, Wide Variety of Proprietary Iron and Steels for Industrial Use Offered by 300 Suppliers: Vol. 100, no. 1, 1937, pp. 65-78.

6 Vignos, James C., Alloy and Alloy Steels in 1936: Blast Furnace and Steel Plant, vol. 25, no. 1, 1937, pp. 74-75.

7 Kinzel, A. B., A Metallurgist's View of Low-Alloy Steels: Steel, vol. 99, no. 3, 1936, p. 40.

8 *See also* Minerals Yearbook, 1935, p. 527, and Minerals Yearbook, 1936, p. 481.

REFRACTORIES

Chrome refractories have been discussed in detail in earlier chapters of this series. Chrome-magnesite roofs have been installed successfully in European open-hearth furnaces for steel melting; higher temperatures are said to be attainable when they are used. Unburned, basic, refractory brick continued to make progress and is finding extensive use. Sullivan [9] has discussed the application and performance of various refractory materials, including chrome refractories.

According to the Bureau of the Census, production of chrome and magnesite brick was 12,112,000 brick valued at $3,424,726 in 1935 compared with 10,640,000 brick valued at $3,091,573 in 1934; stocks were 3,228,000 brick at the end of 1935 compared with 3,336,000 at the end of 1934.

According to trade journals the price of chrome brick during 1936 was $45 per short ton.

CHEMICALS

In addition to the chromite used in the manufacture of chromic acid for electroplating, considerable chromite is consumed in chemicals used principally in the dyeing, tanning, and pigment industries.

PRICES

Prices of chromite quoted in domestic trade journals are for imported ore and are given in dollars per long ton c. i. f. North Atlantic ports. According to Steel, chromite containing 48 percent chromic oxide was quoted at $19.25 at the beginning of 1936. Price increases during the year brought the figure to $21 late in December. Ore with a lower chromic oxide content usually brings a lower price.

WORLD PRODUCTION

Complete data are not yet available on world output of chromite in 1936, but increases in exports and preliminary figures for production indicate that world production increased materially over that in 1935 and established a new record high. Southern Rhodesia and the Union of South Africa recorded large increases in output; these two countries, the U. S. S. R. (Russia), and Turkey are the four major producers. Activities in Turkey continued to expand production, and export figures indicate that output reached a new record in 1936. The following table shows available statistics on world production from 1932 to 1936, inclusive.

[9] Sullivan, John D., Refractories in Metallurgical Industries: Jour. Am. Ceram. Soc. vol. 19, no. 8, 1936 pp. 213–233.

Production of crude chromite, 1932–36, by countries, in metric tons

[Compiled by R. B. Miller]

Country	1932	1933	1934	1935	1936
Australia (New South Wales)	99	905	1,744	605	(1)
Brazil [2]	---	---	---	5	(1)
Bulgaria	---	170	85	325	(1)
Canada (shipments)	71	27	101	1,038	(1)
Cuba [3]	---	24,154	50,162	48,509	71,086
Cyprus (shipments)	1,000	---	982	1,198	(1)
Greece	1,555	14,784	30,694	31,984	(1)
Guatemala [3]	---	2,094	805	---	---
India (British)	18,152	15,775	21,922	39,755	(1)
Japan	12,492	19,897	27,222	36,309	(1)
New Caledonia	69,429	50,072	55,182	55,311	(1)
Norway	409	326	42	---	(1)
Philippine Islands [2]		---	---	1,292	5,006
Rumania	---	29	---	---	(1)
Southern Rhodesia	15,692	35,046	72,099	105,913	183,395
Turkey (Asia Minor)	55,196	75,379	119,844	150,514	(1)
Union of South Africa	19,371	34,078	61,357	90,431	173,141
U. S. S. R. (Russia)	65,900	109,400	127,400	177,900	(1)
United States (shipments)	157	857	375	523	273
Yugoslavia	39,141	26,248	47,352	52,367	54,044
	299,000	409,000	617,000	794,000	(1)

[1] Data not yet available. [2] Exports. [3] Imports into the United States.

WORLD TRADE

Chromite is an important commodity in world trade. Except for the U. S. S. R. (Russia) the principal producing countries consume only small quantities and the major consuming countries produce only a small fraction of their requirements. World exports in 1936 probably were the largest on record and are estimated at 700,000 metric tons. Southern Rhodesia, with a large increase, was the principal exporter followed by Turkey and Union of South Africa.

Figures on imports of chromite into consuming countries in 1936 are not yet complete, but available data indicate that the three principal importing countries, in order of quantity, were the United States, Germany, and Sweden.

A brief summary of the activities in the principal chromite producing and consuming countries, other than the United States, follows.

Canada.—Figures on the production of chromite in Canada during 1936 are not yet available, but a small quantity was produced from the Thetford-Black Lake area of the Eastern Townships of Quebec. Chromite was mined also near Obonga Lake, northwestern Ontario, by the Chromium Mining & Smelting Corporation.

Cuba.—The entire Cuban output moves to the United States; imports into the United States from Cuba in 1936 were 71,086 metric tons compared with 48,509 tons in 1935. Cuban ores are low grade and used principally for refractories.

Cyprus.—The Cyprus Chrome Co., Ltd., continued to develop its chromite deposits on the lease at Troodos.

France.—France depends on foreign sources for its domestic requirements. Imports for the first 11 months of 1936 were 43,666 metric tons.

Germany.—Germany produces no chromite. Imports were 123,375 metric tons in 1936 compared with 95,440 tons in 1935. Of the German imports in 1936, 53 percent came from Turkey and 30 percent from the Union of South Africa.

India.—Production of chromite in India has been increasing, but actual figures for 1936 are not yet available. Waterborne exports declined slightly from 26,472 metric tons in 1935 to 25,389 tons in 1936, however these figures do not include exports through Mormugão which amounted to 15,399 tons in 1935.

New Caledonia.—New Caledonia is one of the important sources of chromite, and preliminary figures indicate that the output in 1936 was 47,837 metric tons. Exports were 78,266 metric tons in 1936 compared with 73,791 tons in 1935. Reductions in the mining tax on chromite were made late in 1936, apparently to encourage the milling of chrome ore in the colony.

Norway.—Imports of chromite into Norway in 1936 were 41,953 metric tons, and exports of ferrochromium were 11,031 tons.

Philippine Islands.—Exploration in the Philippines during recent years appears to have developed a considerable reserve of chromite. Imports of chromite into the United States from the Philippine Islands in 1936 were 5,066 metric tons containing 50 percent Cr_2O_3.

Southern Rhodesia.—The output in 1936 was 183,395 metric tons, an increase of 73 percent over 1935 and the largest since 1930. Southern Rhodesia has again established itself as the principal world producer of chromite.

Southern Rhodesian ore moves through the Port of Beira in Portuguese East Africa for shipment to world markets, and all ore moving through Beira originates in Rhodesia. Chrome ore exported from Beira totaled 185,942 metric tons in 1936 compared with 103,550 tons in 1935.

Sweden.—Imports of chromite into Sweden increased from 41,193 metric tons in 1935 to 50,689 tons in 1936. Exports of ferrochromium from Sweden were 11,342 metric tons in 1935.

Turkey.—Production of chromite in Turkey continued at the high level reached in 1935. Virtually all ore is exported as there is little or no domestic demand; exports in 1936 were 149,642 metric tons, a small increase over the 145,723 tons exported in 1935. The newly discovered deposit near Ergani is being developed and will be in production early in 1937.

Union of South Africa.—Production of chromite in the Union of South Africa in 1936 reached a record figure of 173,141 metric tons compared with 90,431 tons in 1935, an increase of 92 percent. Large increases in output during recent years have made this country one of the chief sources of chromite. Exports in 1936 were 99,242 metric tons, a large increase over the 60,438 tons (revised figure) exported in 1935.

A new deposit on farm Jagdlust No. 333 in the Lydenburg district was being developed during the year. The seam, which is usually about 5 feet thick, comprises friable ore and is exposed by trenching at 150-foot intervals for a distance of 3,000 feet.[10]

Chromite from the Union of South Africa moves to world markets through the port of Lourenço Marques, Portuguese East Africa, and all exports from Lourenço Marques originate in the Union of South Africa. During 1936 there were exported through Lourenço Marques 90,160 metric tons of chromite compared with 96,355 tons in 1935. Of the 1936 shipments, 33,813 tons were consigned to the United States.

U. S. S. R. (Russia).—The U. S. S. R. (Russia) is one of the largest producers of chromite. Output has been increasing and in 1935 amounted to 177,900 metric tons; figures for 1936 are not yet available. Exports are small, as the bulk of the output is consumed in domestic industries.

[10] Department of Mines, Union of South Africa, Quarterly Information Circular, July-September 1936, pp. 5-7.

NICKEL AND COBALT

By Richard J. Lund [1]

SUMMARY OUTLINE

NICKEL

For the second consecutive year world production of nickel has broken all previous records, reflecting the constantly increasing popularity of this metal in its exceedingly diversified uses. Estimated world deliveries of nickel in all forms from all sources during 1936 were 100,000 short tons compared with 80,000 tons in 1935 and 68,000 tons in 1929. Search for new deposits to share in this unprecedented demand continued; and several of unproved size were discovered, chiefly in Canada. Other previously known deposits in many countries, notably Canada, Finland, Japan, and the U. S. S. R. (Russia), were developed to the producing stage. Canada, however, continued to supply about 90 percent of the world's nickel requirements. Productive capacity in the Sudbury district was increased about 30 to 40 percent by the two producing companies, so that full-time operations now will permit an annual output of about 128,000 short tons of nickel. Manufacturers of transportation equipment, particularly the automotive industry, continued to be the principal users of nickel.

Quotations for electrolytic nickel cathodes remained unchanged at 35 cents per pound throughout 1936.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Salient statistics for nickel, 1934–36

	1934	1935	1936
United States:			
Production (all byproduct of copper refining) short tons	157	160	107
Secondary production do	1,850	1,950	1,965
Imports [1] do	29,298	37,848	53,136
Exports [2] do	2,727	2,193	4,078
Price per pound [3] cents	35	35	35
Canada:			
Production short tons	64,344	69,258	84,869
Imports do	345	286	467
Exports do	59,076	71,363	86,819
World production (approximate) do	78,925	83,224	(4)

[1] Exclusive of "All other manufactures of nickel"; weight not recorded.
[2] Exclusive of "Manufactures"; weight not recorded.
[3] Price quoted by International Nickel Co. of Canada, Ltd., for electrolytic nickel at New York, in 2-ton minimum lots.
[4] Adequate information not yet available.

DOMESTIC PRODUCTION

Aside from small quantities of secondary nickel recovered from scrap-nickel anodes, nickel-silver and copper-nickel alloys (including monel metal), and smaller quantities recovered in copper refining, the United States is totally dependent on imports for its nickel supplies.

Capacity of the Huntington (W. Va.) rolling plant of the International Nickel Co., Inc., was expanded by the addition of another 25-ton open-hearth furnace, and the laboratory and office buildings were enlarged.

IMPORTS AND EXPORTS

Nickel content of nickel salts and metallic nickel produced in the United States as a byproduct in the electrolytic refining of copper, 1927–31 (average) and 1932–36

Year	Short tons	Value	Year	Short tons	Value
1927–31 (average)	481	$279,212	1934	157	$108,414
1932	195	88,515	1935	160	129,500
1933	126	62,913	1936	107	(1)

[1] Bureau of Mines not at liberty to publish value.

Secondary nickel recovered as metal and in nonferrous alloys and salts in the United States, 1927–36

Year	Short tons	Value	Year	Short tons	Value
1927–31 (average)	3,440	$2,408,000	1934	1,850	$1,295,000
1932	1,450	1,015,000	1935	1,950	1,365,000
1933	1,650	1,155,000	1936	1,965	1,375,000

Value of nickel imported into and exported from the United States, 1925–29 (average) and 1932–36

Year	Imports for consumption: Nickel, nickel ore and matte, nickel oxide, and alloys of nickel with copper, etc.	Imports for consumption: Manufactures and nickel sheets and strips	Imports for consumption: Total	Exports: Nickel, monel metal, and other alloys	Exports: Manufactures	Exports: Nickel silver or German silver in bars, rods, or sheets	Exports: Nickel-chrome electric resistance wire	Exports: Total
1925–29 (average)	$11, 830, 285	$177, 747	$12, 008, 032	$772, 008	$846, 292	$296, 272	(1)	[2]$1,920,972
1932	4, 660, 489	33, 941	4, 694, 430	635, 399	432, 173	43, 219	$250, 681	1, 361, 472
1933	10, 746, 721	15, 696	10, 762, 417	546, 878	504, 760	57, 645	285, 033	1, 394, 316
1934	13, 409, 338	21, 995	13, 431, 333	1, 505, 286	738, 515	95, 562	372, 900	2, 712, 263
1935	17, 128, 213	53, 325	17, 181, 538	1, 207, 048	1,101,476	114, 218	325, 009	2, 747, 751
1936	23, 785, 759	27, 489	23, 813, 248	3, 060, 339	3,635,430	144, 176	414, 542	7, 254, 487

[1] Not separately recorded.
[2] Includes nickel salts valued at $6,400 in 1929 and $55,277 in 1930; not separately recorded for other years.

Nickel imported for consumption in the United States, 1934–36, by classes

Class	1934 Pounds	1934 Value	1935 Pounds	1935 Value	1936 Pounds	1936 Value
Unmanufactured:						
Nickel ore and matte	11, 845, 865	$1, 608, 515	15, 924, 300	$2, 087, 259	23, 194, 329	$3, 048, 966
Nickel alloys, pigs, bars, etc	45, 799, 511	11, 616, 100	58, 858, 726	14, 877, 182	80, 528, 455	20, 259, 508
Nickel oxide	950, 236	184, 723	912, 907	163, 772	2, 550, 073	477, 285
Manufactured:						
Nickel silver or German silver in sheets, strips, and rods	75	74				
All other manufactures of nickel	(1)	21, 921	(1)	53, 325	(1)	27, 489
		13, 431, 333		17, 181, 538		23, 813, 248

[1] Quantity not recorded.

Nickel exported from the United States, 1934–36, by classes.

Class	1934 Pounds	1934 Value	1935 Pounds	1935 Value	1936 Pounds	1936 Value
Nickel / Monel metal and other alloys	4, 576, 459	$1, 505, 286	3, 452, 590	$1, 207, 048	6, 876, 594	$3, 060, 339
Manufactures	(1)	738, 515	(1)	1, 101, 476	(1)	3, 635, 430
Nickel-chrome electric resistance wire	345, 482	372, 900	264, 633	325, 009	328, 749	414, 542
Nickel silver or German silver in bars, rods, or sheets	531, 339	95, 562	668, 448	114, 218	950, 803	144, 176

[1] Quantity not recorded.

USES

The uses of nickel are far too numerous to list here. Alloyed with iron and many other nonferrous metals or employed as metallic nickel, it meets the peculiar physical, chemical, and æsthetic qualities required in literally thousands of uses. Its ability to impart great strength and corrosion resistance to alloys is its outstanding characteristic. Other uses depend on the magnetic qualities found in alloys containing certain percentages of nickel. Manufacture of

transportation equipment, particularly automobiles, continues as the dominant field of nickel consumption. For strengthening steels used in such highly stressed parts as axles, shafts, gears, connecting rods, valves, crankshafts, and steering knuckles and arms, nickel is generally specified, commonly with one or more other alloying elements. An important recent development is the expanding use of nickel in cast iron;[2] many automotive manufacturers now specify this material for crankshafts and camshafts. In busses, trucks, and railroad rolling stock (both passenger and freight) the tendency to reduce deadweight to a minimum has accelerated consumption of nickel steels and other nickel alloys to save weight without sacrificing strength and safety. High strength-to-weight ratios and corrosion resistance of nickel alloys continue to make them suitable for highly stressed vital parts of ships and airplanes.

Other important industrial uses of nickel alloys are in equipment for petroleum producing and refining, mining, road and building construction, and food and beverage preparation and in the chemical, electric, textile, agriculture, pulp and paper, and steel industries.

Undoubtedly acceleration of rearmament throughout the world has furnished an important outlet for nickel, as it is almost indispensable in the manufacture of munitions, armor plate, and other mechanized equipment used in modern warfare.

Considerable progress was made in bright nickel plating. New developments in this field have been summarized by Johnson.[3]

A detailed discussion of trends in nickel consumption may be found in The Nickel Industry in 1936, by Robert C. Stanley, President, International Nickel Co. of Canada, Ltd.

WORLD PRODUCTION

World production of nickel (content of ore) in 1932–36, by countries, in metric tons

[Compiled by R. B. Miller]

Country	1932	1933	1934	1935	1936
Australia (Tasmania)	1	9			
Brazil		31	39	5	478
Canada	13,756	37,768	58,371	62,830	76,992
Germany				272	(1)
Greece	953	1,377	1,063	(2)	(1)
India, British	945	989	1,188	1,488	1,320
Morocco, French				186	(1)
New Caledonia	5,000	5,000	8,600	6,300	(1)
Norway	975	969	1,334	1,235	(1)
Southern Rhodesia				58	71
U. S. S. R. (Russia)			863	1,829	(1)
United States [3]	177	114	142	145	97
	21,807	46,257	71,600	75,500	(1)

[1] Data not yet available.
[2] Estimate included in total.
[3] Byproduct in electrolytic refining of copper.

Canada.—For years production from the Sudbury district in Ontario has yielded about 90 percent of the world output of nickel, and reserves are adequate to furnish similar proportions for decades to come. Output in 1936 was the greatest ever recorded in Canada's

[2] Merica, Paul D., Progress in the Improvement of Cast Iron and the Use of Alloys: Howe Lecture delivered before 147th Meeting of Am. Inst. Min. and Met. Eng., New York, Feb. 18, 1937.
[3] Johnson, L. W., Bright Nickel Plating: Met. Ind., Feb. 26, 1937, pp. 281-286. *See also* The Metal Industry, First International Electrodeposition Conference, Mar. 5, 1937, pp. 303-318.

mining history: 169,737,864 pounds valued at $43,878,413 were produced, compared with 138,516,240 pounds valued at $35,345,103 in 1935. Two companies, the International Nickel Co. of Canada, Ltd., and Falconbridge Nickel Mines, Ltd., continued to be the main producers.

The International Nickel Co. of Canada, Ltd.,[4] operated at capacity throughout 1936 and completed another expansion program by which its capacity was raised by about a third to 10,000 tons of nickel per month. Two mines, the Frood and Creighton, produced 4,299,329 short tons of ore; the former yielded 3,408,956 tons and the latter 890,373 tons. The Frood now has enough stopes in operation to yield 13,000 tons of ore per day. The concentrator treated 3,317,988 tons of ore; construction work finished during the year now permits a daily throughput of 11,000 tons, an increase of a third over its previous capacity. The Port Colborne nickel refinery, which operated full time, produced 103,860,757 pounds of nickel; its capacity was increased 50 percent during the year. Sales of principal products by the company increased as follows from 1935 to 1936, respectively: Nickel in all forms, from 64,925 to 84,464 short tons; copper from 116,505 to 132,977 tons; and platinum from 128,874 to 220,980 ounces. From 1932 to 1936, inclusive, total sales of copper averaged 1.73 pounds per pound of nickel sold and sales of platinum 1.14 ounces per 1,000 pounds of nickel sold.

Falconbridge Nickel Mines, Ltd.,[5] was forced to shut down its smelter in September owing to a fire at the Government plant supplying power, but the company refinery in Kristiansand, Norway, continued operations at capacity throughout the year, and sales of nickel increased from 10,829,865 pounds in 1935 to 11,252,893 in 1936. Copper sales were 5,149,215 pounds in 1936, compared with 5,129,483 in 1935. Ore treated totaled 327,783 tons in 1936, of which 126,782 tons were milling ore and 201,001 tons smelting ore. The ore averaged 1.9 percent nickel and 0.92 percent copper. An extensive expansion program was completed in December, in both the Ontario and Kristiansand works, which will permit production and treatment of 36,000 tons of ore monthly. For 12 months of operation and at 1936 metal yields the annual productive capacity would be about 15,000,000 pounds of nickel and 7,000,000 pounds of copper. New mine development proved up considerably more ore than was taken out in 1936; ore reserves were 5,331,076 tons at the end of 1936, compared with 4,059,475 tons at the close of 1935.

Complete details concerning new developments at both International Nickel and Falconbridge operations were presented by Hubbell.[6]

Other small producers were Cuniptau Mines, Ltd., with an output of some copper-nickel matte from its smelter in the Temagami district, Ontario, and the B. C. Nickel Mines, Ltd., which produced nickel-copper ore from development work at its property at Choate, British Columbia. According to widely circulated reports, the latter company made two shipments of ore (500 and 1,000 tons) to Japan for testing which assayed 4 to 5 percent nickel and about 2 percent copper.

Diamond drilling has proved up what appears to be a sizeable ore body on the property of Denison Nickel Mines, Ltd., in the Sudbury Mining Division.[7] Extensive development work is planned.

[4] International Nickel Co. of Canada, Ltd., Annual Report, 1936.
[5] Falconbridge Nickel Mines, Ltd., Eighth Annual Report, 1936.
[6] Hubbell, A. H., Sudbury Stepping Up Production: Eng. and Min. Jour., September 1936, pp. 453–459.
[7] Northern Miner, Jan. 14, 1937, sec. 3, p. 34.

Other discoveries were reported near Lake Athabasca, Saskatchewan,[8] and near Kenora, Ontario.[9]

Finland.—Prospecting and development of the Petsamo deposits by the Mond Nickel Co., Ltd., continued throughout the summer of 1936 with what were said to be favorable results. Considerable equipment was transported to the fields, and some 50 kilometers of road were built. The company plans to construct an electric railway from the ore fields to Liinahamari, a distance of about 50 kilometers, and a survey of the route was begun. Construction of a hydroelectric power plant on the Pats River is another part of the project. A shipment of 400 tons of ore for testing purposes from Petsamo to Swansea was reported.[10]

India, British.—The Burma Corporation, Ltd., continued to ship nickel-bearing speiss from its mines in the Northern Shan States.

Japan.—Of considerable importance to the Japanese was the formation of the Japan Nickel Co. in 1936, with an authorized capital of 5,000,000 yen (about $1,500,000). Detailed plans have not been published, but it is stated that a small plant with an annual capacity of 350 to 400 tons of nickel will be ready to operate by April 1937. Ore will be drawn from deposits in Gumma Prefecture, which are said to contain about 30,000,000 metric tons averaging 0.33 percent nickel.[11]

Netherland India.—Samples of ore from the recently discovered Boeloe-Balang nickel deposits in central Celebes were sent to Europe for testing. The main ore body is reported to comprise about 320,000 tons of about 1.96 percent nickel, above which are 500,000 tons of weathered material some 1 to 5 meters thick which assays 1 to 1.5 percent nickel.[12]

New Caledonia.—The first important shipment of nickel from New Caledonia to Japan was made when a cargo of 3,000 tons of ore was loaded on the *Manju Maru* at Kua in October. The ore came from the Ouli-Ouli mine, which is owned and exploited by the Japanese.

The mining operations of the Société Calédonickel were reported late in 1936 to be at capacity; three mines were producing (the Guerioum Nos. 215, 70, and 174), and monthly production averaged about 4,500 metric tons. Another mine, the C. F., will begin production soon.[13]

Norway.—The refinery of Falconbridge Nikkelverk, Aktieselskap, at Kristiansand, operated at capacity through the year on matte shipped from the Falconbridge smelter near Sudbury, Ontario, Canada. Enlargement of the refinery to permit an annual output of some 7,000 tons of nickel was completed during the year.

United Kingdom.—The Clydach nickel refinery of the Mond Nickel Co., Ltd., produced 18,152 tons of nickel in the form of pellets and 1,281 tons of nickel in salts in 1936. Productive capacity was increased to an annual output of 21,000 tons, and late in the year the company opened its new research and development laboratory at Birmingham. An excellent account of the history of nickel processing in the United Kingdom is now available.[14]

---

[8] Wall Street Journal, Oct. 20, 1936.
[9] Vice Consul H. T. Dwyer, Fort William and Port Arthur, July 27, 1936.
[10] Consul General Herbert S. Goold, Helsingfors, Aug. 10, 1936.
[11] Crane, Burton, Japan: Eng. and Min. Jour., February 1937, p. 85.
[12] Metall-woche, Erschliessung von neuen Erzvorkommen: No. 11, Berlin, Mar. 14, 1936, p. 206.
[13] La Chronique des Mines Coloniales, Paris, Jan. 1, 1937, p. 38.
[14] Henry Wiggin & Co., Ltd., One Hundred Years of Progress: Centenary pub.

U. S. S. R. (*Russia*).—An easily movable nickel smelter was completed at Rezh about 80 kilometers from Sverdlovsk in the Urals late in 1936, and the first matte was produced in November. It is proposed to operate the plant on the many small nickel deposits scattered through the Urals. Refining of the matte will be done at the Ufalei plant.

Mining is said to have begun on the reputedly extensive nickel deposits near Monchegorsk above the Arctic Circle and some 600 miles north of Leningrad.[15]

COBALT

World production of cobalt is centered in the Belgian Congo, Northern Rhodesia, Canada, and Morocco, and for many years there has been close agreement among the producers as to production and marketing. This was culminated by the formation of the Cobalt Association in October 1934 which comprised principal producers in the Belgian Congo, Northern Rhodesia, Canada, and Morocco. The Association of German Cobalt Producers joined it in 1935. The agreement, which was due to expire in August 1936, was renewed for 5 years, an indication of its successful functioning in the past.

Although complete statistics on production are not available (the principal gap during the past few years being in the Belgian Congo output), it is apparent that an all-time record for world production of cobalt was established in 1936.

Prices.—Quoted prices for cobalt ore are in cents per pound of contained cobalt in carload lots f. o. b. shipping point in Ontario and range from 40 cents for ores containing 8 to 9 percent Co to 55 cents for those assaying over 14 percent. These quotations remained unchanged throughout 1936, but the keen demand for cobalt ores resulted in sales at considerably higher figures. The New York contract price for cobalt metal, less quantity discounts, remained at $1.25 throughout the year, while the London price stood steady at 5s. 3d. The spot price on 500-pound lots in London strengthened from 5s. 3d. in January to 6s. in May and to 7s. in November. The domestic quotation for black oxide (70 to 71 percent Co) opened 1936 at $1.39 to $1.49 per pound, was reduced 10 cents per pound on January 20 when the Canadian trade agreement became effective (reducing the duty 50 percent, from 20 to 10 cents per pound), and was raised to $1.41 to $1.51 early in May (where it remained the rest of the year).

The London quotation of 4s. 10½d. to 5s. in the early part of 1936 was raised in June (5s. to 5s. 6d.) and again in November (5s. 4½d. to 5s. 7½d.). The extension of the cobalt cartel doubtless helped to strengthen prices.

DOMESTIC PRODUCTION

Reported occurrences of cobalt minerals are numerous, but the size and grade of these deposits are such as to preclude their commercial development under prevailing prices. A recent Government report presented details concerning mineral supplies in the Boulder Dam area, and conclusions concerning possible supplies of cobalt in the region (mainly in the Yellow Pine or Goodsprings district in southern Nevada, from which small shipments of cobalt ore were made in 1922) were as follows: [16]

[15] Bureau of Foreign and Domestic Commerce, Metals and Minerals: Jan. 29, 1937, and Dec. 9, 1936.
[16] U. S. Geological Survey, Mineral Resources of the Region Around Boulder Dam, Bull. 871, 1936, p. 87.

* * * Without much doubt several hundred tons of material containing about 2 percent of cobalt could be readily produced from existing explorations, but conditions do not warrant the hope for a large reserve.

A western electrolytic-zinc plant recovered 6.438 tons of residues in 1936 which contained 4.084 percent Co, but no shipments were made.

Thus the United States has been wholly dependent for many years on imports for its supplies of cobalt.

IMPORTS

Cobalt ore, cobalt (metal), oxide, and other compounds of cobalt imported for consumption in the United States, 1933–36

	1933		1934		1935		1936	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Cobalt ore	556,119	$117,261	748,513	$47,435	419,110	$46,608	1,039,760	$77,965
Cobalt (metal)	281,713	331,828	506,119	599,791	563,866	630,289	883,377	1,014,965
Oxide	568,057	413,584	328,730	258,172	557,083	503,445	813,642	885,566
Sulphate	51,045	13,225	43,590	11,350	80,082	23,333	46,472	16,502
Other salts and compounds	48,186	14,607	197	395	472	679	186	277

Cobalt and cobalt ore imported into the United States, 1934–36, by countries

Country	1934		1935		1936	
	Pounds	Value	Pounds	Value	Pounds	Value
Australia	76,388	$6,719	34,225	$2,184		
Austria					37	$280
Belgium	431,750	518,856	498,659	559,543	870,868	998,897
Canada	708,850	81,553	384,885	44,424	1,026,320	75,565
France	1,602	2,195				
Germany	36,042	37,903	63,007	67,852	4,482	5,030
India, British					13,440	2,400
United Kingdom			2,200	2,894	7,990	10,758
		647,226		676,897		1,092,930

USES

The principal uses of cobalt are somewhat evenly divided between the metallurgical and ceramic fields. Metallurgical uses are for high-speed cutting steels, for making stellite alloys (cobalt and chromium, commonly with small amounts of other metals) used for cutting metals at high speed, and for making permanent magnets. Small quantities of the metal are also used as a binder in making cemented tungsten carbides. Announcement was made early in 1936 that a new nickel-cobalt-aluminum alloy "Alnico" had been developed by the General Electric Co. Permanent magnets made of it are able to lift as much as 60 times their own weight when designed for that purpose. A noteworthy development in cobalt plating during 1936 was the discovery that the use of small quantities of cobalt with other chemicals in nickel-plating solutions permits production of bright nickel electrodeposits as an undercoating for later chromium plating.[17]

[17] Weisberg, Louis, Use of Cobalt-Nickel Solutions to Produce Bright Electrodeposits: Steel, July 13, 1936, p. 43.

The principal use of the oxide is in the ceramic industry, where its coloring properties are utilized in fine china and glassware. Other compounds of cobalt are employed as driers in paint and varnish.

WORLD PRODUCTION

World production of cobalt, 1934–36, in metric tons

[Compiled by M. T. Latus]

Country	Cobalt-bearing material	1934		1935		1936	
		Gross weight	Cobalt content	Gross weight	Cobalt content	Gross weight	Cobalt content
Australia: Queensland	Cobaltite concentrates, etc.	(1)	8			(1)	(1)
Canada: Ontario	Cobalt, alloys, and chemicals	(1)	270	(1)	309	(1)	400
India, British: Burma [2]	Cobaltiferous nickel speiss	3,861	135	4,492	157	4,669	163
Japan	Cobalt concentrates			191	(1)	(1)	(1)
Morocco, French	Cobalt ore; average cobalt content estimated at 11 percent.	1,618	178	4,070	445	3,370	371
Northern Rhodesia	Cobaltiferous copper ore	(1)	581	(1)	417	(1)	461

[1] Data not available.
[2] Year ended June 30 of year stated.

Belgian Congo.—Production of cobalt by the Union Minière du Haut Katanga continued and presumably increased to correspond with the larger copper output.

Canada.—The Ontario Department of Mines reported total production of cobalt (including metal and metallic content of oxides sold and of ores and residues exported) at 881,995 pounds valued at $801,857 in 1936 compared with 681,419 pounds valued at $512,705 in 1935. Exports of cobalt metal, alloys, oxides, salts, and ores were valued at $842,947 in 1936 compared with $541,554 in 1935. The Nipissing Mining Co., Ltd., shipped most of the cobalt ore, but the Agaunico mine became an important shipper during the last half of the year. It was reported that the Nipissing company, while sinking along an old cobalt vein, ran into a sizable deposit late in 1936.[18] Smaller shipments were made by many other operators and numerous lessees. Much of the cobalt production from this camp now comprises small clean-up operations underground in areas where cobalt-bearing ground was left in the earlier silver-boom days. In addition, considerable cobalt is recovered by hand-sorting at old waste dumps.

By far the larger part of the cobalt ore or concentrates produced in this district in 1936 was exported as such; the remainder was shipped to the Deloro smelter for processing into metal or oxides (principally the latter). Cobalt contained in silver ores shipped from the O'Brien mine near Cobalt is also recovered at Deloro.

Morocco.—The Société Minière de Bou-Azzer et du Graara continued development of its mine at Bou-Azzer about 180 kilometers southeast of Marrakech in the Anti-Atlas and shipped cobalt ore to Europe throughout 1936. Cobalt production in Morocco totaled 371 metric tons in 1936 compared with 445 tons in 1935. A detailed microscopic study [19] revealed that the principal cobalt mineral is skutterudite ($CoAs_3$), associated in places with safflorite (orthorhombic

[18] The Northern Miner, 2d sec., Oct. 15, 1936, p. 17.
[19] Orcel, J., and Jouravsky, G., Le Minerai de cobalt de Bou-Azzer (Maroc), sa composition, mineralogie, et structure: Cong. Internat. Min., Metal. et Geol. Appl., 7th sess., Paris, Oct. 20–26, 1935; sec. geol. appl., t. I, 1936, pp. 207–216.

$CoAs_2$) and with löllingite ($FeAs_2$). Erythrite is found at the outcrop. In places the ore carries considerable gold.

Northern Rhodesia.—Production of cobalt in Rhokana cobaltiferous copper ore was 461 metric tons in 1936 compared with 417 tons in 1935. A new selective flotation process was evolved by the Rhokana Corporation for treating the cobalt-copper ore from the Nkana mine, by which converter slag lower in copper and higher in cobalt is produced from a separate cobalt concentrate.[20] United States Patent 2058126 was granted to F. L. Bosqui of Nkana for a process by which ferrocobalt is produced by electrolytic treatment of a cobalt-iron-copper alloy.[21]

[20] Bosqui, F. L., The Separation of Cobalt and Copper Minerals by Selective Flotation: South African Min. and Eng. Jour., Jan. 18, 1936, pp. 661–662.
[21] U. S. Patent Office Official Gazette: Vol. 471, no. 3, Oct. 20, 1936, p. 626.

MOLYBDENUM, TUNGSTEN, AND VANADIUM

By RICHARD J. LUND [1]

SUMMARY OUTLINE

MOLYBDENUM

Probably no other metal has experienced as phenomenal a growth in output during the past decade as molybdenum; molybdenite is one of the few common ferro-alloying minerals of which the United States has ample supplies for its own needs. During the past decade, domestic production increased from 1,143 short tons of molybdenum in concentrates in 1927 to 8,593 tons in 1936, or roughly 750 percent. This remarkable increase has been due to the growing realization that alloy steels and more recently alloy irons containing small amounts of molybdenum can better meet the ever more rigid and exacting specifications of manufacturers of steel and iron equipment for myriads of special uses.

In recent years the United States has produced 75 to 90 percent of the world output of molybdenum. The relatively small production in foreign countries comes mainly from Norway and Mexico. Exports of molybdenum from the United States are not known exactly, since they are not separately classified in trade statistics, but they are believed to comprise 50 to 75 percent of the domestic production.

During 1936 a construction program by which the productive capacity of the principal producer, Climax Molybdenum Co., will be almost doubled was virtually completed. Of considerable importance, also, was the entry of Utah Copper Co. as a producer of molybdenite

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce. Figures on domestic production compiled by H. W. Davis, of the Bureau of Mines.

concentrates from its open-pit operation at Bingham. In an emergency this expansion of productive capacity might prove of inestimable value to the United States, for in certain vital uses it has been found that molybdenum can substitute for other alloying metals of which domestic supplies are deficient for even normal requirements. Even with operations scaled up to developed capacity, the known reserves of molybdenum are adequate for at least several decades.

Prices.—Prices for molybdenite concentrates carrying 90 percent MoS_2 were quoted nominally by the Engineering and Mining Journal at 42 cents per pound of contained MoS_2 throughout 1936. London prices for the same grade of concentrates were quoted in January 1936 at 34s per long ton unit (22.4 pounds of MoS_2) and strengthened to 35s in February and to 37s in March, where they held until December when the quotation rose to 39s. This price rise was equivalent to an increase of from 38 cents per pound of MoS_2 in January to 43½ cents in December.

Salient statistics of the molybdenum industry in the United States, 1934–36 [1]

	1934	1935	1936
Production:			
Ore ... short tons	1, 339, 000	1, 384, 000	2, 269, 00
Concentrates ... do	9, 119	11, 786	17, 68
Molybdenum contained:			
Average ... percent	51. 33	48. 84	48. 5
Total ... pounds	9, 362, 000	11, 512, 000	17, 186, 00
Shipments (molybdenum contained):			
Pounds	9, 377, 000	[2] 10,892, 000	17, 959, 00
Value [3]	$6, 502, 000	[2] $7,261, 000	$11, 933, 00
Imports (molybdenum contained):			
Pounds	213, 928	68, 758	4
Value	$124, 156	$40, 721	$21

[1] Figures for molybdenum exported not separately recorded.
[2] Revised figures.
[3] Estimated by Bureau of Mines.

DOMESTIC PRODUCTION

Arizona.—The Arizona Molybdenum Corporation maintained steady operations at its property on Copper Creek near Mammoth, Pinal County, and treated 87,021 short tons of ore during 1936, from which 1,165 tons of concentrates containing 1,320,891 pounds of molybdenum were recovered.

The Molybdenum Gold Mining Co., a subsidiary of the Molybdenum Corporation of America, continued to mine complex ore from the oxide zone in the Mohawk and New Year claims near Mammoth, from which gold, silver, lead, molybdenum, and vanadium were recovered in its flotation mill. Near by the Mammoth-St. Anthony, Ltd., produced similar ore from its Mammoth mine, which was treated in the Molybdenum Gold Mining Co. mill. Cooperative work between the United States Bureau of Mines, the Missouri School of Mines, and the Mammoth-St. Anthony, Ltd., by which successful flotation methods for treating these complex ores were developed, was described by Clemmer and Cooke.[1] Recent developments in the area, including a brief geologic description of the properties together with an outline of milling methods, were summarized by Huttl.[2] The capacity of the

[1] Clemmer, J. Bruce, and Cooke, S. R. B., Flotation of Complex Molybdenum-Vanadium Ores from Mammoth, Arizona: Rept. of Investigations 3333, Bureau of Mines, 1937, 51 pp.
[2] Huttl, J. B., Gold and Molybdenum from Rehabilitated Mines in Mammoth, Arizona: Eng. and Min. Jour., June 1936, pp. 286–287.

mill is reported to have been increased from 200 to 300 tons of ore per day.

Colorado.—The Climax Molybdenum Co., world's largest producer of molybdenum, operated its mine and mill at capacity throughout 1936, having mined 1,994,926 tons of ore from which 14,211 tons of concentrates containing 15,216,806 pounds of molybdenum were recovered. The phenomenal growth in production by this company is indicated by the following table:

Molybdenum (element) contained in concentrates produced from the Climax deposit, Colorado, 1918–36 [1]

	Pounds		Pounds
1918	342, 200	1930	3, 083, 000
1919	152, 648	1931	2, 644, 399
1924	156, 935	1932	1, 913, 395
1925	821, 757	1933	5, 028, 695
1926	1, 057, 367	1934	8, 378, 683
1927	1, 858, 228	1935	10, 168, 635
1928	2, 957, 845	1936	15, 216, 806
1929	3, 529, 295		

[1] None produced, 1920–23, inclusive.

The elaborate construction program recently undertaken by the company, leading toward an increase in productive capacity from about 4,000 to some 10,000 to 12,000 short tons of ore per day, and addition of modern surface housing for employee welfare were virtually completed late in 1936, although it was expected that full operations at the new rate would not be reached until the spring of 1937. Detailed descriptions of recent developments at Climax were presented by Coulter,[3] and a lengthy article [4] giving an account of the growth of this great enterprise also appeared recently. As an additional step in its progressive program, Climax started construction of a new laboratory in Detroit, Mich., to be used for research in connection with sales-promotion work.[5]

New Mexico.—The Molybdenum Corporation of America operated its mine and mill, some 7 miles east of Questa along the Red River, continuously throughout 1936. Most of the ore treated was mined by leasers from older parts of the property, company miners having been engaged principally in development work on a lower level just being opened up. The ore is relatively high grade and the tonnage treated comparatively low.

Utah.—A notable development in the domestic molybdenum industry in 1936 was the successful recovery of molybdenite from copper ores mined and treated by the Utah Copper Co. from its huge open-pit operation at Bingham. The annual report of the Kennecott Copper Corporation describes this new development as follows:

> The principal metallurgical development of the year was the inauguration of the production of molybdenite as a byproduct from the concentration of certain copper ores. Research in the separation of this mineral had been under way for many months, but it was not until the last quarter of the year that production was begun in a small way. Marketing of the product was commenced in December. While the outlook for earnings from this new source is promising, no definite evaluation of the amount thereof can be made at this time.

[3] Coulter, W. J., Climax: The Explosives Engineer, November 1936, pp. 323–329. Coulter, W. J., Molybdenum Operations at Climax: Mining Cong. Jour., January 1937, pp. 54–56.

[4] Fortune, Element Number Forty-Two: October 1936, p. 105.

[5] Iron Age, June 4, 1936, p. 95.

A later report,[6] quoting D. D. Moffat, general manager of Utah Copper Co., stated that the value of the molybdenite recovered is only a few cents to the ton of crude copper ore treated; and E. T. Stannard, president of Kennecott Copper Corporation, later released a statement[7] that production was running at about 700,000 pounds of MoS_2 per month. This amounts to 420,000 pounds of Mo monthly or about 5,000,000 pounds per year. Maintenance of operations at a rate permitting this production would be contingent on conditions in the copper market; fluctuations in copper production would result in fluctuations in molybdenite output.

Washington.—The Deertrail Monitor Mining Co. (409 Metals Bldg., Spokane) did considerable development work at its Monitor mine near Fruitland, Stevens County, installed a 50-ton mill, and started operating late in December. Crude ore mined during 1936, mainly in development work, amounted to 2,000 tons, the ore running about 1 percent MoS_2. Only 200 tons were treated, from which 2 tons of concentrates were recovered.

Installation of a 50-ton concentrating plant and mining of 500 tons of molybdenite ore were reported by Copper Mining Co. (Goose Prairie, Wash.), at its property near Yakima, Yakima County. The company expects to be in production by the summer of 1937.

IMPORTS AND EXPORTS

Imports of molybdenum or compounds of molybdenum are negligible. Exports of molybdenum, principally in the form of concentrates, are a very important item in the domestic molybdenum industry. Exact figures are not available, since molybdenum is not separately classified in export statistics; but it is reasonably certain that 50 to 75 percent of the domestic production of concentrates is exported. In 1936 roughly two-thirds of the total United States production of concentrates was shipped abroad.

Molybdenum ore and concentrates, ferromolybdenum, molybdenum metal and powder, calcium molybdate, and other compounds and alloys of molybdenum imported for consumption in the United States, 1927–36

Year	Molybdenum content (pounds)	Value	Year	Molybdenum content (pounds)	Value
1927	14,198	$16,184	1932	44	$89
1928	576	1,385	1933	670	601
1929	1,627	2,384	1934	213,928	124,156
1930	144,963	283,846	1935	68,758	40,721
1931	210,766	213,660	1936	49	213

USES

Molybdenum is used principally in the iron and steel industry for making special alloy steels to be used under high fatigue loads, scorching temperatures, tremendous pressures, or severely corrosive conditions. It may be employed alone as an alloying material but commonly is added along with such other well-known ferro-alloy metals as chromium, nickel, tungsten, manganese, and silicon. Use of molybdenum high-speed tool steels for cutting metal at high speeds,

[6] Engineering and Mining Journal, April 1937, p. 203.
[7] Engineering and Mining Journal, Metal and Mineral Markets, May 13, 1937, p. 3.

and therefore high temperatures, is apparently expanding;[8] such steels contain approximately 8 percent molybdenum and 2 percent tungsten, along with small amounts of chromium, vanadium, or possibly cobalt. The manufacture of automobiles, trucks, busses, airplanes, railroad equipment, and equipment for petroleum producing and refining constitute important outlets for the use of molybdenum-bearing alloys. Increasing quantities of this metal have recently gone into the manufacture of cast iron which must withstand certain severe requirements. Detailed discussions of the uses of molybdenum in steel and iron and of the many applications of these products in industry may be found in the numerous pamphlets issued by Climax Molybdenum Co.[9]

A promising use for molybdenum is in a new method for bright-plating zinc developed by Grasselli Chemical Co.[10] A new process for the electrodeposition of molybdenum was also announced during the year.[11]

WORLD PRODUCTION

Although at least 80 percent of the molybdenum output of the world is produced by the United States, small tonnages are mined in a few foreign countries.

World production of molybdenum ores and concentrates,[1] 1932–36, in metric tons

[Compiled by M. T. Latus]

Country	1932	1933	1934	1935	1936
Australia:					
New South Wales (concentrates)	4	6	3		(2)
Queensland (concentrates)	2	5	1	11	(2)
China (ore containing 45 percent Mo)	(3)	1	2	(3)	(2)
Chosen (ore)	45	105	104	106	(2)
Japan (dressed ore)			5	6	(2)
Mexico (content Mo)	3	40	467	687	534
Morocco, French (concentrates)[4]	(3)	117	149	190	(2)
Norway (content Mo)	158	248	146	388	(2)
Peru (concentrates)	7	9	15	13	19
Rumania (Bi-Mo ore)			6	14	(2)
United States (content Mo)	1,103	2,577	4,247	5,222	7,795
Yugoslavia				18	(2)

1 Molybdenum content of ores and concentrates not available.
2 Data not yet available.
3 Less than 1 ton.
4 Exports.

Canada.—A 150-ton flotation mill was installed at the property of the Phoenix Molybdenite Corporation in Renfrew County, eastern Ontario, and considerable development work was done on the mine, ore from which is said to run 1 to 1.5 percent MoS_2.[12]

Mexico.—The Mexican output of molybdenum comes entirely as a byproduct from the Greene Cananea Copper Co. operation, where labor difficulties caused cessation of work during part of the year.

Norway.—Production comes entirely from the Knaben mine near Kristiansand; exports of molybdenite were 745 tons of concentrates in 1936 compared with 627 tons in 1935.

8 Steel, Molybdenum-Tungsten High Speed Steel is Finding Wide Acceptance in Industry: Mar. 15, 1937, p. 66.
9 Climax Molybdenum Co., Molybdenum in Industry; Molybdenum in Steel; Molybdenum in the Foundry; and The Moly Matrix (monthly): 500 Fifth Ave., New York.
10 Iron Age, Oct. 5, 1936.
11 Chemical Industries, vol. 39, no. 6, December 1936, p. 597.
12 Metal Bulletin (London), June 19, 1936, p. 12; Sept. 22, 1936, p. 11.

TUNGSTEN

In company with all other ferro-alloy metals, tungsten in 1936 continued the remarkable recovery that began in 1934. The world production in 1935 (exclusive of Spain and Argentina)—21,900 metric tons of equivalent 60-percent WO_3 concentrates—was the largest on record, except for the two peak war years 1917 and 1918, when world output was 25,797 and 31,917 metric tons, respectively. Data are not yet at hand on which to base even a rough estimate of world production for 1936, but it seems likely from the few details available that the 1936 figures will at least equal and may very well surpass those for 1935. Although production in China has increased markedly since 1934, the most striking feature in the world picture has been the phenomenal rise in exports from Burma, which during 1936 apparently exceeded those from China.

United States production, which had been ample for the meager apparent domestic consumption during the worst depression years, continued to rise, but not nearly as rapidly as did consumption. Imports therefore increased sharply.

Prices.—London prices for Chinese wolfram concentrates containing 65 percent WO_3, as quoted by the Mining Journal (London), opened 1936 at about 35s per long-ton unit of WO_3, c. i. f., declined steadily to a low of 25s in August, recovered to 29s in September, and finally rose to about 32s 6d in December. According to the Engineering and Mining Journal domestic scheelite quotations were steady at $16 per short-ton unit of WO_3 in January-May, inclusive, then declined to a low of $14 in August, after which they rose again to $15.50–$16 in December.

Salient statistics of the tungsten industry in the United States, 1935–36

	1935		1936	
	Short tons	Value	Short tons	Value
Concentrates shipped (60 percent WO_3)	2,395	$1,921,017	2,612	$2,323,818
Imported for consumption (W content)	446	461,961	1,883	1,676,823
Stocks in bonded warehouses, Dec. 31:				
Ore (W content)	654	497,730	541	414,616
Metal (W content)	20	34,205	4	8,798

DOMESTIC PRODUCTION

Under the impetus of the favorable prices that prevailed during 1936, particularly throughout the last few months of the year, domestic tungsten mining enterprises increased the output from established producing operations and undertook considerable development work to reopen old but dormant properties. The output of tungsten concentrates in 1936 (reduced to equivalent 60 percent WO_3) amounted to 2,612 short tons compared with 2,395 tons in 1935, an increase of 9 percent. Production was reported from Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, and Washington; of these, Nevada maintained its position as the largest producer.

Salient features of the domestic tungsten industry have been summarized by Leith and Liddell [13] and later by Segerstrom.[14]

Concentrated tungsten ores (reduced to equivalent of 60 percent WO_3) produced in the United States, sold in 1927–36, and average price per unit

Year	Short tons	Value	Average price per unit	Year	Short tons	Value	Average price per unit
1927	1,164	$724,000	$10.37	1932	396	$218,394	$9.20
1928	1,208	753,900	10.40	1933	895	514,234	9.58
1929	830	654,000	13.13	1934	2,049	1,791,316	14.57
1930	702	509,000	12.09	1935	2,395	1,921,017	13.37
1931	1,404	928,000	11.02	1936	2,612	2,323,818	14.83

Arizona.—Shipments of tungsten concentrates from Arizona operations in 1936 totaled 423 short tons averaging 69.42 percent WO_3, compared with 339 tons averaging 69.78 percent WO_3 in 1935.

By far the largest operator was the Boriana Mining Co., producing wolframite concentrates from its Boriana mine near Yucca, Mohave County. The tunsten occurrence here was recently briefed by the United States Geological Survey.[15] The Southwest Ore Corporation shipped 12 tons of hübnerite concentrates averaging 63 percent WO_3 from its Las Guijas mine near Arivaca in Pima County before selling the property to the General Electric Co. The latter company did not operate the mine in 1936 after acquiring it. Hübnerite concentrates were also shipped by A. H. Yeagley from surface operations near Dragoon, Cochise County. About 17 tons of scheelite concentrates running 71.14 percent WO_3 were shipped from the Tungsten Reef mines near Hereford, operated by J. J. Seeman, and additional scheelite was shipped by Gold, Silver, & Tungsten, Inc., from the Huachuca claims in the same vicinity.

California.—Shipments of scheelite concentrates increased considerably in 1936 over 1935, output having been reported from two operations—the Atolia mine of the Atolia Mining Co. near Atolia in San Bernardino County and the tungsten-gold placer of Atolia Rand Placers, Inc., in the same vicinity. The former company is the larger producer and reported a 1936 output of 22,524 tons of ore averaging 0.8 percent WO_3, from which 186 tons of concentrates running 67.26 percent WO_3 were recovered and about 180 tons shipped. A brief description of operations in this area was given by the United States Geological Survey.[16]

A. E. Beauregard reported development work on his Black Rock group of scheelite claims near Bishop, Mono County, and the United States Vanadium Corporation on its Pine Creek mine near Independence.

Colorado.—Tungsten operations in Colorado center around the ferberite veins in Boulder County. The two largest operators are the Wolf Tongue Mining Co., operating a mill at Nederland, and Gold, Silver, & Tungsten, Inc., with a mill at Tungsten. Total shipments

[13] Leith, K., and Liddell, D. M., The Mineral Reserves of the United States and Its Capacity for Production: National Resources Committee, Washington, D. C., March 1936, pp. 224–228.
[14] Segerstrom, C. H., The American Tungsten Industry: Mining Congress Journal, January 1937, p. 50.
[15] Hewett, D. F., and others, Mineral Resources of the Region Around Boulder Dam: U. S. Geol. Survey Bull. 871, 1936, p. 89.
[16] Hewett, D. F., and others, Mineral Resources of the Region Around Boulder Dam: U. S. Geol. Survey Bull. 871, 1936, p. 90.

from the State in 1936 were 256 short tons of concentrates running 42.25 percent WO_3 compared with 519 tons running 45.06 percent WO_3 in 1935. Both of the above companies purchase ore, usually in very small lots, from as many as a hundred small operators and leasers, in addition to operating their own mines. Of the purchased material, about half is obtained by hand-sorting old dumps, simple hand jigs being used at many operations. Old tailings are also being reworked. W. L. Tanner reported 488 tons of crude ore mined from the Tanner Group; from this 29 tons of concentrates running about 66 percent WO_3 were recovered. Shipments totaled 21 tons.

Idaho.—Operations were started at the Ima mine on Patterson Creek about 11 miles east of May by the Ima Mines Corporation; 800 tons of ore were mined and milled at this operation in 1936, and about 15 tons of 65-percent WO_3 concentrates and 100 tons of sulphide concentrates containing silver, copper, and lead were recovered. Recent installation of new flotation equipment and jigs now permits a daily output of about 1,000 pounds of tungsten concentrates and 3 tons of sulphide concentrates.

Nevada.—Nevada retained its position as the largest tungsten producer in 1936, with a total output of 1,631 short tons of equivalent 60 percent WO_3 concentrates. Most of the output came from mines of the Nevada-Massachusetts Co. near Mill City, augmented by considerable production from mines of the same company at Silver Dyke near Mina. Both operations produce scheelite but are quite different geologically. The Mill City deposits are tungsten-bearing contact-metamorphosed thin limestone beds within slates, whereas the Silver Dyke deposits, recently described in detail by Kerr,[17] are tungsten-bearing quartz-albite veins associated with a diorite stock that intrudes presumably Triassic volcanics and intercalated sediments. Operations at Mill City were continuous throughout the year at the present milling capacity of about 250 tons a day. A new flotation unit was added to the mill to decrease slime losses.

According to Kerr, the Silver Dyke operation consists of more than a mile of tunnels and drifts, milling capacity is about 100 tons a day, and production at the present rate should total 250 to 300 tons of scheelite concentrates a year. Capacity was recently increased by improvement in milling, which was made possible by more abundant water supplies brought in from the nearby Pilot Range.

The Rare Metals Corporation of New York completed its new milling plant at Toulon on U. S. Highway 40 and the Southern Pacific Ry. about 10 miles southwest of Lovelock, and operations presumably began late in the year. The 150-ton mill will draw ore from the recently discovered Oreana deposit operated by the same company and also from several small operations owned by other individuals in the vicinity.

Washington.—Tungsten Producers, Inc., mined 1,900 tons of ore from its Germania mine near Fruitland, Stevens County, from which 38 tons of wolframite concentrate assaying 69 percent WO_3 were recovered and shipped between April 1 and October 1. The General Electric Co. purchased the property on July 1, took over operations on October 1, and did nothing but development work for the remainder of the year.

[17] Kerr, Paul F., The Tungsten Mineralization at Silver Dyke, Nev.: Univ. of Nevada Bull., vol. 30 no. 5, June 15, 1936.

Tungsten Mines, Inc., turned over control of its property about 17 miles northeast of the Germania mine to the Standard Chemical & Engineering Co. of Chicago.

IMPORTS AND EXPORTS

Domestic supplies of tungsten, which were adequate for the greatly reduced demand during the depression years 1932–33, inclusive, are insufficient for requirements during periods of normal industrial activity, so the United States imports both tungsten concentrates and products, principally the former. Imports of ore and concentrates for consumption (tungsten content) amounted to 3,586,293 pounds in 1936, more than four times the 1935 imports of 812,622 pounds. In addition, 579,027 pounds of tungsten in concentrates were imported in bond for smelting, refining, and export compared with 815,038 pounds in 1935. Imports of tungsten ore and concentrates and of tungsten metal and compounds in 1935 and 1936, by countries, are shown in the following tables:

Tungsten ore and concentrates imported into the United States, 1935–36, by countries

Country	1935			1936		
	Gross weight (pounds)	Tungsten content (pounds)	Value	Gross weight (pounds)	Tungsten content (pounds)	Value
Argentina	23,565	12,080	$4,944	21,758	11,597	$6,304
Australia				236,254	135,195	67,686
Belgium				188,462	104,582	48,576
Bolivia				94,780	47,011	17,628
British Malaya	163,871	90,020	45,692	741,582	436,871	198,588
Canada				74,667	40,996	17,735
China	1,237,840	669,143	317,381	4,800,582	2,559,254	1,067,728
France				3,281	1,815	726
Hong Kong	220	45	13	85,209	42,224	18,370
Japan				56 000	29,120	13,169
Mexico	50,777	34,470	11,412	187,102	95,815	36,570
Netherland India	11,040	6,864	4,214			
Peru				77,800	37,686	18,298
Sweden				55,519	30,341	11,372
Union of South Africa				25,531	13,786	6,908
	1,487,313	812,622	383,656	6,648,527	3,586,293	1,529,658

Tungsten in metal and compounds imported into the United States, 1935–36, by countries

Country	Tungsten (metal) and tungsten carbide [1]				Tungstic acid and other compounds of tungsten			
	1935		1936		1935		1936	
	Tungsten content (pounds)	Value	Tungsten content (pounds)	Value	Tungsten content (pounds)	Value	Tungsten content (pounds)	Value
Austria	408	$4,188	389	$1,701				
Canada			1,988	1,700				
Germany	1,271	8,686	11	134	537	$1,874	210	$761
Hungary							175	1,170
United Kingdom	77,038	63,557	177,703	141,699				
	78,717	76,431	180,091	145,234	537	1,874	385	1,931

[1] Includes combinations containing either metal or carbide.

Since 1931 the great bulk of our exports of tungsten products has consisted of shipments of ferrotungsten to the U. S. S. R. (Russia). Exports during 1936 of tungsten metal, wire, shapes, and other alloys amounted to 103,877 pounds valued at $615,081. Exports of ferrotungsten are now grouped with ferrosilicon and ferrovanadium, so that a reasonably close estimate of total tungsten metal in various compounds and alloys exported is no longer possible.

CONSUMPTION AND USES

Apparent consumption.—Owing to the change in classification of exports containing tungsten, it is no longer possible to make a reasonably accurate estimate of apparent domestic consumption.

Uses.—The principal uses of tungsten are in the manufacture of high-speed tool steels, cemented tungsten carbides, stellites, and electric light and radio-tube filaments; in the preparation of various chemicals, such as pigments; and in the tanning of white leather. Detailed discussion of these uses may be found in previous chapters of the Minerals Yearbook. Reference is also made to the recently revised reference book covering the production, metallurgy, properties, and applications of tungsten by Smithells [18] and to the chapter on tungsten by W. P. Sykes in Modern Uses of Nonferrous Metals, A. I. M. E. Series, 1935 (pp. 376–388). A recent development that offers promise of new outlets for the metal is the electrodeposition of tungsten with other metals in binary, ternary, and even quaternary combinations.[19]

WORLD PRODUCTION

Virtually all the important producing countries have shared in the increased demand for tungsten during the past 3 years.

World production of tungsten ore, 1932–36, by countries, in metric tons of concentrates containing 60 percent WO_3

[Compiled by M. T. Latus]

Country [1]	1932	1933	1934	1935	1936
North America:					
Mexico			80	54	57
United States	359	812	1,859	2,173	2,370
	359	812	1,939	2,227	2,427
South America:					
Argentina	6		392	(2)	(2)
Bolivia [3]	686	240	794	1,423	(2)
Peru			12	37	(2)
	692	240	1,198	1,460	(2)
Europe:					
Germany (Saxony)			1		(2)
Great Britain (Cornwall)	2	12	223	256	(2)
Portugal	272	358	610	1,140	1,367
Spain	43	46	49	(2)	(2)
	317	416	883	1,396	(2)

[1] In addition to the countries listed, tungsten ore is produced in the U. S. S. R. (Russia), but no data of production are available for the period under discussion.
[2] Data not available.
[3] Exports.

[18] Smithells, Colin J., Tungsten: 2d ed., D. van Nostrand Co., New York, 1936, 272 pp.
[19] Tungsten Electrodeposit Corporation, Electrodeposition of Tungsten with Other Metals: Pamphlet, Washington, D. C., July 11, 1936; Steel, Mar. 9, 1936, p. 40.

World production of tungsten ore, 1932–36, by countries, in metric tons of concentrates containing 60 percent WO_3—Continued

[Compiled by M. T. Latus]

Country	1932	1933	1934	1935	1936
Asia:					
China [3]	2,249	6,000	5,099	7,998	7,638
Chosen	62	144	399	949	(2)
India, British (Burma)	2,226	3,056	3,913	4,527	(2)
Indochina (Tonkin)	247	250	300	417	(2)
Japan	22	31	70	96	(2)
Malay States:					
Federated Malay States	378	1,188	1,921	1,720	(2)
Unfederated Malay States	175	91	90	315	(2)
Netherland India	----------	----------	1	1	(2)
Siam	----------	----------	36	82	(2)
	5,359	10,760	11,829	16,105	(2)
Africa:					
Nigeria	----------	----------	5	16	(2)
Southern Rhodesia	14	33	117	26	88
South-West Africa	----------	3	18	53	46
Tanganyika Territory	----------	----------	----------	5	(2)
Union of South Africa	----------	----------	----------	9	46
	14	36	140	109	(2)
Oceania:					
Australia:					
New South Wales	27	(4)	59	63	(2)
Northern Territory	15	13	89	141	(2)
Queensland	8	14	41	27	(2)
Tasmania	----------	123	230	275	(2)
New Zealand [3]	9	19	39	61	(2)
	59	169	458	567	(2)
	6,800	12,400	16,400	[5] 21,900	(2)

[2] Data not available.
[3] Exports.
[4] Less than 1 ton.
[5] Exclusive of Argentina and Spain.

Argentina.—Shipments during the past 2 years have amounted annually to about 350 tons of concentrates (chiefly wolframite) assaying about 70 percent WO_3; production has come from deposits controlled by American capital.[20]

China.—Exports officially recorded totaled 7,638 metric tons of equivalent 60-percent WO_3 concentrates in 1936 compared with 7,998 tons in 1935. The outstanding feature in the Chinese tungsten trade in 1936 was the development of a central monopoly, the Nanking Tungsten Bureau, functioning under the National Resources Commission of the Nanking Government, which apparently assumed effective control of all Chinese sources of tungsten. Other provincial monopolies, such as the Kiangsi Wolfram Mining Bureau and the Canton Monopoly, which had functioned independently during the past few years, were either abolished or made subsidiary to the central bureau. This change was effected in about midyear. Troop movements caused a brief cessation of production in southern Kiangsi late in July, but output was resumed in August. Local prices slumped severely during July–October, following rapid liquidation of stocks by the local monopoly, but with gradual depletion of speculators' stocks and effective control by the new monopoly prices gradually recovered, and at the close of the year the market was firm.

[20] U. S. Bureau of Mines, Mineral Trade Notes: Nov. 20, 1936, p. 16.

Hong Kong.—An important development in Hong Kong was the granting by the Hong Kong Government of a concession of some 540 acres near Needle Hill, in the New Territories, to Marsman & Co., of Manila, for the exploitation of tungsten deposits believed to exist there.

India, British.—The entire production comes from Burma, principally from the Hermingyi mine, near Tavoy, and the Mawchi mine, in the southern part of Karenni State. Exports of mixed tin and wolfram concentrates during 1936 were 8,553 metric tons, compared with 7,600 tons in 1935; most of these shipments went to the United Kingdom. Construction of a new direct motor route between the Mawchi mine and the main railway at Toungoo was completed and opened for traffic late in 1936; it is expected to permit substantial savings in transport charges. Prospecting on the company lease east of the present mine workings has revealed a large area of mineralized granite weathered so thoroughly and deeply that it can probably be worked at an extremely low cost by sluicing or other large-scale surface methods.[21]

Malay States.—Exploration work at the Kramat Pulai mine, the main source of tungsten (principally scheelite) concentrates in this area, apparently proved disappointing, since it was reported[22] that the total ore located up to midyear would only suffice to keep the mill running some 21 months. Exports, almost entirely scheelite, totaled 1,395 metric tons in 1936, almost identical with 1935.

Southern Rhodesia.—Development work by St. Swithin's Ores & Metals, Ltd., on its Tshontanda wolframite operation has warranted the erection of a plant to treat 120 tons a day; construction was started late in 1936. Additional claims containing tungsten have been staked by the company along a belt over 40 miles long.[23] Production totaled 88 metric tons in 1936 compared with 26 tons in 1935.

U. S. S. R. (Russia).—Two discoveries of tungsten were reported in Kasakstan—one in the Chingis-Tow Mountains near Karkaralinsk and the other in the Akchetow Mountains about 140 kilometers northeast of the new copper works on Balkash Lake and 80 kilometers from the Turkestan-Siberian Railway.[24] Development work proceeded on a scheelite deposit in the Shirin-raion (Kasakstan), where a shaft was sunk and an experimental mill constructed.[25]

VANADIUM

Recovery of the vanadium industry was in full swing in 1936, following the severe depression drop which resulted in virtually complete cessation of world output during 1933 and 1934. Production in the United States, now centering around vanadium recovery in complex ores from Arizona, in carnotites from Colorado and Utah, and in vanadium ore from Colorado and Arizona, increased considerably in 1936 but was still inadequate to meet domestic requirements. Imports from Peru therefore supplemented domestic supplies by 1,867 short tons of concentrates containing 171 short tons of vanadium in 1936 compared with 476 short tons of concentrates containing 47 tons of vanadium in 1935. Following extensive development work and installation of new milling equipment in 1936 by the

[21] U. S. Bureau of Mines, Mineral Trade Notes: Nov. 20, 1936, p. 14.
[22] Metal Bulletin (London), July 21, 1936, p. 15.
[23] South African Mining and Engineering Journal, June 6, 1936, p. 478.
[24] Metal Bulletin (London), Nov. 17, 1936, p. 14.
[25] U. S. Bureau of Foreign and Domestic Commerce, Russian Economic Notes: Nov. 30, 1936, p. 11.

United States Vanadium Corporation at Uravan, Colo. (near the old Paradox Valley carnotite operations), and by the International Vanadium Corporation near Dripping Springs, Ariz., forthcoming production from these operations will go a long way toward making the United States self-sufficient in this important ferro-alloy mineral.

Steady operations were resumed by the Vanadium Corporation of America at its Minasragra mine in Peru and also by the South-West Africa Co., Ltd., at its Abenab mine in South-West Africa; both mines were reopened late in 1935, so that production outside the United Stated totaled 912 metric tons of vanadium in concentrates in 1936 compared with 416 tons in 1935.

According to verbal advice from C. Rees, vice president, Vanadium Corporation of America, some 50,000 pounds of V_2O_5 are recovered annually from boiler and stack soot of ships burning Venezuela and Mexican oil for fuel. Until recently, much of this was recovered and marketed by various contractors on the east coast of the United States who cleaned the boilers of these ships during their calls here, but apparently much of this business is now being done in Europe. The soot runs anywhere from 2 to 34 percent V_2O_5, the richer recoveries being made by tankers operating in and near Maracaibo Lake, Venezuela. Soot from Mexican oil averages around 6 percent V_2O_5.

Purely nominal quotations for vanadium ore were unchanged through 1936 at 27½ cents per pound of contained V_2O_5.

Salient statistics of the vanadium industry in the United States, 1935–36

	1935		1936	
	Quantity	Value	Quantity	Value
Production:				
Carnotite ores [1] ....short tons..	1,145	$56,223	1,439	$73,881
Vanadium contained........pounds..	50,776	(2)	52,695	(2)
Vanadium and complex ores........short tons..	(3)	(3)	74,299	(3)
Vanadium contained........pounds..	(3)	(3)	86,817	(3)
Imports:				
Vanadium ores........short tons..	476	40,070	1,867	155,730
Vanadium contained........pounds..	94,080	....	342,720	....

[1] Also contained radium and uranium as follows: Radium—1935, 3,329 milligrams; 1936, 2,716 milligrams; uranium—1935, 22,009 pounds; 1936, 17,961 pounds.
[2] Figures not available.
[3] Bureau of Mines not at liberty to publish figures.

DOMESTIC PRODUCTION

Production in the United States of vanadium contained in all types of ores from which it was recovered totaled 139,512 pounds in 1936. The Bureau is not at liberty to publish total figures for 1935.

Arizona.—Continuous operations were carried on at the properties of the Molybdenum Gold Mining Co. and the Mammoth-St. Anthony, Ltd., near Mammoth, where complex ores containing recoverable values in gold, silver, lead, molybdenum, and vanadium are treated in a flotation mill operated by the former company. Clemmer and Cooke [26] presented results of cooperative work between the United States Bureau of Mines, the Missouri School of Mines and Metallurgy, and the Mammoth-St. Anthony, leading to successful flotation of these complex ores.

[26] Clemmer, J. B., and Cooke, S. R. B., Flotation of Complex Molybdenum-Vanadium Ores from Mammoth, Ariz.: Rept. of Investigations 3333, Bureau of Mines, 1937, pp. 21–38.

Colorado and Utah.—The production of vanadium in carnotite mined in scattered localities through western Colorado and southeastern Utah amounted to 52,695 pounds in 1936 compared with 50,776 pounds in 1935. Reports cite construction of small 25-ton mills to treat low-grade carnotites by Utah Vanadium Corporation at Cedar, Colo., and the Rare Metals, Inc., near Moab, Utah.

The United States Vanadium Corporation completed construction of a 125-ton mill and roasting plant, together with an office building and model town to house about 125 men at Uravan, Colo., and production was started late in 1936. Extensive deposits of low-grade vanadium ore left behind in the old carnotite operations in the Paradox Valley area, together with waste dumps of vanadium-bearing material, constitute an important reserve to maintain operations here for many years.

USES

The principal use of vanadium is in making special alloy steels and irons, and minor amounts are employed in the form of ammonia meta-vanadate as a catalyst in the manufacture of sulphuric acid. Further details concerning its use may be found in former reports of this series in Minerals Yearbook, in the A. I. M. E. series, Modern Uses of Nonferrous Metals (pp. 213–216), and in the pamphlet, Vancoram Ferro-Alloys, issued by the Vanadium Corporation of America in 1936.

WORLD PRODUCTION

Aside from resumption of steady operations at the Minasragra mine in Peru and the Abenab mine in South-West Africa, there are no important foreign developments to cite. Production at the latter operation was increased steadily in 1936, until late in the year it amounted to about 450 long tons of concentrates averaging 19.75 percent V_2O_5 per month, all of which is exported. World production is shown in the following table:

World production of vanadium in ores and concentrates, 1932–36, in metric tons

[Compiled by R. B. Miller]

Country	1932	1933	1934	1935	1936
Northern Rhodesia	307	36	3	173	204
Peru			[1] 133	67	161
South-West Africa	305	18	34	176	547
United States	245	2	([2])	([2])	63

[1] Shipments from stock.
[2] Bureau of Mines not at liberty to publish figures.

BAUXITE AND ALUMINUM

By Herbert A. Franke and C. T. Herring[1]

SUMMARY OUTLINE

Activity in the bauxite and aluminum industries of the United States returned to predepression levels in 1936. Bauxite production was the largest since 1928, and the aluminum output was less than 2 percent below the peak production of 1930. Apparent consumption of bauxite and primary aluminum showed large increases over 1935 and approached all-time peaks. There was a slight decline in the average value of bauxite sold by producers, but the quoted price of aluminum was unchanged. Producers' stocks again were reduced substantially during the year.

Outside the United States, production and consumption of bauxite and aluminum in 1936 exceeded all previous records. Germany was the outstanding aluminum producer abroad, having increased its output 37 percent above that in 1935. Activity in the foreign industry was due primarily to armament and nationalistic programs, although recovery in general industrial activity and new uses also were important factors. Construction of several new plants and additions to old plants were completed or begun during 1936.

Salient statistics of the bauxite and aluminum industries in the United States, 1929 and 1935–36

	1929	1935	1936
Bauxite:			
Production ... long tons	365,777	233,912	372,005
Value	$2,265,638	$1,556,595	$2,198,523
Average per ton	$6.19	$6.65	$5.91
Imports ... long tons	380,812	199,959	322,790
Exports (including concentrates) ... do	133,551	82,491	84,471
World production ... do	2,115,000	1,716,000	[1] 2,559,000
Aluminum:			
Primary production ... short tons	[2] 113,987	59,648	112,465
Value	$51,864,000	$22,070,000	$41,612,000
Quoted price per pound [3] ... cents	23.9	20.5	20.5
Secondary production ... short tons	48,400	51,400	51,500
Imports	$10,860,009	$4,279,014	$5,181,264
Exports	$7,971,085	$2,067,230	$1,609,328
World production ... short tons	312,300	285,800	394,200

[1] Estimated.
[2] Revised figure.
[3] New York: 1929, virgin metal 98–99 percent pure; 1935–36, 99 percent plus pure virgin ingot.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

BAUXITE

PRODUCTION

Arkansas accounted for 95 percent of the total quantity of bauxite mined in the United States in 1936. Nine underground and open-pit mines near Bauxite in Saline County furnished much of Arkansas' output, and the rest came from five properties near Sweet Home, Pulaski County. Alabama and Georgia contributed the remaining 5 percent of domestic production. There were two producers in Alabama at Eufaula, Barbour County, and three in Georgia—two at Andersonville, Sumter County, and one at Kingston, Bartow County.

Bauxite of domestic origin shipped in 1932–36

Year	Alabama and Georgia		Arkansas		Total	
	Long tons	Value f. o. b. mine	Long tons	Value f. o. b. mine	Long tons	Value f. o. b. mine
1932	6,570	$40,471	89,779	$507,697	96,349	$548,168
1933	11,997	69,541	142,179	853,718	154,176	923,259
1934	12,074	71,991	145,764	1,057,062	157,838	1,129,053
1935	14,121	91,293	219,791	1,465,302	233,912	1,556,595
1936	17,062	109,327	354,943	2,089,196	372,005	2,198,523

Bauxite producers in the United States in 1936

American Cyanamid & Chemical Corporation, 30 Rockefeller Plaza, New York, N. Y.—Rauch shaft mine, Pulaski County, Ark., and Hatton shaft mine, Sumter County, Ga.

Arkansas Bauxite Corporation, Bauxite, Ark. (mining by West Bauxite Mining Co.)—Standard shaft mine, Saline County, Ark.

Crouch Mining Co., Inc., P. O. Box 35, Bridge Station, Niagara Falls, N. Y.—England shaft mine, Pulaski County, Ark.

Dixie Bauxite Co., Inc., Sweet Home, Ark.—Dixie No. 2 shaft mine, Pulaski County, Ark.

Benjamin Easterlin, Americus, Ga.—Easterlin open-pit mine, Sumter County, Ga.

Charles Lennig & Co., Inc., 222 West Washington Square, Philadelphia, Pa.—Lennig open-pit mine, Barbour County, Ala.

Pulaski Bauxite Co., 301 Southern Building, Little Rock, Ark.—Pulaski open-pit mine, Pulaski County, Ark.

Republic Mining & Manufacturing Co., 230 Park Avenue, New York, N. Y.—Davis and Crosscut No. 23 shaft mines, open-pit mines in secs. 14, 15 (area B), and 23, and Maud Nos. 1, 2, and 3, Saline County, Ark.; Sweethome open-pit and shaft mine, Pulaski County, Ark.; and Eufaula open-pit mine, Barbour County, Ala.

Southern Minerals, Inc., 302 Standard Building, Atlanta, Ga.—A new producer at Kingston, Bartow County, Ga.

The bauxite in Saline and Pulaski Counties, Ark., is the result of superficial alteration of nepheline syenite. Bramlette's [2] investigation, which included the drilling of test holes and some surface mapping, shows that large quantities of nonmerchantable bauxite occur between two areas of syenite. Although a blanket of bauxite may have formed upon the syenite projecting above the contact of the Midway and Wilcox groups of the Eocene, the syenite occurring below this geological horizon is little altered and is not accompanied by bauxite. Bramlette's report gives detailed information on the occurrence of the bauxite as well as the possibility of more extensive reserves in undiscovered deposits.

[2] Bramlette, M. N., Geology of the Arkansas Bauxite Region: Arkansas Geol. Survey Inf. Circ. 8, 1936, 68 pp.

The other principal bauxite occurrences in the United States are in southeastern and northeastern Alabama and in central and northwestern Georgia. The Chattanooga district of Tennessee has not produced bauxite since 1928, and the low-grade deposits in north-central Mississippi have not been worked commercially. The alunites in Utah and other States and possibly the leucites of Wyoming must also be considered in any study of aluminum ore reserves.

CONSUMPTION BY INDUSTRIES

Bauxite is used in the manufacture of aluminum, chemicals, abrasives, cements, and refractories. The following table shows the shipments of domestic bauxite for these purposes during the past 5 years.

Domestic bauxite shipped by producers in the United States, 1932–36, by consuming industries, in long tons

Year	Aluminum	Chemical	Abrasive [1]	Cement and refractory [1]	Total	Year	Aluminum	Chemical	Abrasive [1]	Cement and refractory [1]	Total
1932	28,899	61,838	5,612	--------	96,349	1935	112,154	66,316	53,684	1,758	233,912
1933	46,506	89,226	18,444	--------	154,176	1936	211,990	73,972	84,363	1,680	372,005
1934	55,630	67,153	34,580	475	157,838						

[1] Small quantity of bauxite shipped to makers of refractories probably included under Abrasive.

Aluminum.—The aluminum industry consumed 57 percent of the domestic bauxite production in 1936. All bauxite used in the manufacture of aluminum is shipped to East St. Louis; here both Arkansas and South American bauxites are refined to alumina, which is shipped to aluminum-reduction plants in carload lots. Of the aluminum produced in 1936, about half was derived from domestic bauxite and half from imported South American bauxite. Some alumina is exported to Canada and Norway for reduction purposes, and a small portion is consumed in other uses.

Although alunite, leucite, and high-alumina shales and clays have been employed to produce aluminum, bauxite at present is the only commercial ore. Japan is experiencing difficulty in producing a good-quality aluminum from alunite and Manchurian shales, and the Aurelia plant in Italy failed in its first attempt to make commercial metal from leucite. Although Germany can produce aluminum from its rich clay deposits in Saxony, the process is by no means economical. Bauxite is paramount not only for its high content of alumina but also its low content of silica. Silica is undesirable because it is soluble in the hot, alkaline solutions by means of which alumina (Al_2O_3) is extracted most easily from ores. In making alumina in the United States by the Bayer process, a silica content up to 7 percent is permitted. The typical bauxite contains 55 to 65 percent alumina, 2 to 5 percent silica, 1 to 25 percent ferric oxide, 1 to 3 percent titanium dioxide, and 10 to 30 percent combined water. United States bauxites probably average 58 percent alumina and 5 to 6 percent silica. Approximately 2 tons of bauxite are required to make 1 ton of alumina, and 2 tons of alumina are required to make 1 ton of aluminum. Cheap electrical power is necessary to reduce alumina to metallic aluminum. To make 1 ton of aluminum it is said that 24,000 kilowatt-

hours of electricity, 22,000 cubic feet of natural gas, and 9 tons of raw materials (including bauxite, coal, soda ash, limestone, fluorspar, cryolite, petroleum coke, pitch, and other materials) are required.

Chemical.—In 1936, manufacturers of aluminum salts consumed 170,561 long tons of domestic and foreign bauxite, an increase of 32 percent over 1935. The average cost of this material at consumers' plants was $10.99 per ton. This tonnage included 20 percent of the total domestic shipments. In addition to bauxite, aluminum-salts manufacturers used 859 short tons of aluminum metal in 1936.

The following tables, which show the quantity of aluminum salts produced in recent years, do not include alumina made as a preliminary step in the manufacture of aluminum.

Aluminum salts produced in the United States, 1935–36

Salt	1935		1936	
	Number of producers	Short tons	Number of producers	Short tons
Alum:				
Ammonia	5	5,121	6	5,610
Potash	3	2,685	3	3,070
Other	1			
Sodium-aluminum sulphate	3	18,216	(1)	(1)
Aluminum chloride:				
Liquid	5	1,302	5	1,721
Crystal	2	4,936	2	5,465
Anhydrous	4		4	
Aluminum sulphate:				
Commercial	22	346,177	23	384,782
Iron-free	7	17,806	7	16,053
Other aluminum salts and hydrate	6	[2] 22,313	8	46,236
		[2] 418,556		462,937

[1] Included under "Other aluminum salts and hydrate."
[2] Revised figures.

Aluminum salts of domestic origin shipped in 1935–36

Salt	1935				1936			
	Number of shippers	Short tons	Value: Total	Value: Average	Number of shippers	Short tons	Value: Total	Value: Average
Alum:								
Ammonia	5	4,904	$264,861	$54	5	5,763	$302,884	$53
Potash	3	2,718	152,948	56	3	2,852	159,664	56
Other	1							
Sodium-aluminum sulphate	3	18,067	1,038,463	57	(1)	(1)	(1)	
Aluminum chloride:								
Liquid	5	1,322	65,474	50	5	1,733	80,876	47
Crystal	3	839	80,997	97	3	753	70,844	94
Anhydrous	4	4,424	477,511	108	4	5,020	587,743	117
Aluminum sulphate:								
Commercial:								
General	12	336,474	6,906,235	21	13	376,839	7,727,472	21
Municipal	10	10,511	166,153	16	10	11,331	180,084	16
Iron-free	7	17,098	555,674	32	7	16,182	527,850	33
Other aluminum salts and hydrate	[2] 6	[3] 21,864	[3] 1,467,515		[2] 8	45,439	2,924,643	
		[3] 418,221	[3] 11,175,831			465,912	12,562,060	

[1] Included under "Other aluminum salts and hydrate."
[2] 1935: 5 producers of alumina and 4 producers of sodium aluminate; 1936: 5 producers of alumina, 5 producers of sodium aluminate, and 2 producers of sodium-aluminum sulphate.
[3] Revised figures.

Aluminum salts shipped in, imported into, and exported from the United States, 1932–36

Year	Domestic shipments		Imports		Exports (aluminum sulphate) [1]	
	Short tons	Value	Short tons	Value	Short tons	Value
1932	320,016	$8,113,437	1,505	$65,859	21,550	$462,954
1933	370,879	9,355,698	1,094	51,490	28,270	543,945
1934	373,330	9,630,464	726	38,620	30,881	594,440
1935	[2] 418,221	[2] 11,175,831	1,499	76,316	33,091	685,347
1936	465,912	12,562,060	2,238	62,226	28,788	578,001

[1] Also "other aluminum compounds" as follows: 1932, 326 short tons, valued at $58,789; 1933, 428 tons, $70,011; 1934, 488 tons, $93,440; 1935, 691 tons, $126,435; 1936, 1,483 tons, $250,262.
[2] Revised figures.

Aluminum sulphate, usually prepared by the digestion of bauxite in sulphuric acid, is used principally in water purification, in paper making, and as a mordant in dyeing. Aluminum chloride is used in carbonizing wool and in the refining of petroleum. The many uses of sodium-aluminum sulphate and the alums are given by Umhau.[3]

Activated alumina, a partly dehydrated aluminum trihydrate, is used as a commercial adsorbent in dehumidification and air conditioning, in the adsorption of gases and vapors, in the removal of water from liquids, in the adsorption of substances in true or colloidal solution, as a filtering medium, and as a catalyst or catalyst carrier. Aluminum monohydrate D ($Al_2O_3.H_2O$), characterized by very low bulk density and small particle size, is used in the insulation of high-temperature operations. Crude alumina, left as tailings from the World War treatment of Marysvale (Utah) alunite for its potash content, is now sold by the Mineral Products Corporation to copper smelters and refiners for use as a mold wash in casting anode bars. This production, however, is not included in the aluminum-salts statistics.

Abrasive.—The abrasive industry consumed 23 percent of the 1936 domestic production of bauxite. Some of the bauxite exported from Arkansas to Canada is used in artificial abrasives. Much of the so-called emery paper and polishing compounds and various types of grinding wheels and whetstones are made of fused bauxite.

Cement and refractory.—The cement and refractory industries consumed less than 1 percent of the bauxite produced in the United States during 1936. However, a small quantity of bauxite sold to makers of refractories is probably credited to the abrasive industry. Alumina-cement manufacturers require a bauxite with less than 2 percent silica and therefore import most of their requirements, chiefly from Europe. Bauxite brick, a high-aluminum refractory, is made from calcined bauxite in varying proportions with a bonding material of fireclay, sodium silicate, or lime. The use of bauxite in making synthetic mullite, an aluminum silicate refractory, has increased the past few years. The diasporic (high-alumina) clays produced in central Missouri supplant bauxite in the manufacture of some refractories.

Bauxite consumers in the United States in 1936

Aluminum Ore Co., East St. Louis, Ill.
American Cyanamid & Chemical Corporation, 30 Rockefeller Plaza, New York, N.Y.
Atlas Lumnite Cement Co., 208 South La Salle Street, Chicago, Ill.
Birmingham Water Works Co., Birmingham, Ala.
Board of Public Utilities, Kansas City, Kans.
Bogalusa Paper Co., Bogalusa, La.

[3] Umhau, John B., Alums and Aluminum Sulphate: Inf. Circ. 6882, Bur. of Mines, 1936, 32 pp.

Brown Co., Berlin, N. H.
Bureau of Water Supply, Baltimore, Md.
The Carborundum Co., Niagara Falls, N. Y.
City of Columbus Purification Works, Columbus, Ohio.
Columbus Water Works, Columbus, Ga.
Continental Chemical Co., Sand Springs, Okla.
Dalecarlia Filter Plant, Washington, D. C.
Davison Chemical Corporation, 8 East Long Street, Columbus, Ohio.
E. I. du Pont de Nemours & Co., 1007 Market Street, Wilmington, Del.
Exolon Co., Blasdell, N. Y.
Federal Abrasives Co., Anniston, Ala.
General Abrasive Co., Inc., Niagara Falls, N. Y.
General Chemical Co., 40 Rector Street, New York, N. Y.
General Refractories Co., 106 South Sixteenth Street, Philadelphia, Pa.
Gulf Oil Corporation, Gulf Building, Pittsburgh, Pa.
Harbison-Walker Refractories Co., Pittsburgh, Pa.
Hercules Powder Co., Wilmington, Del.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Charles Lennig & Co., Inc., 222 West Washington Square, Philadelphia, Pa.
Louisiana Chemical Co., Inc., Bastrop, La.
Massillon Stone & Fire Brick Co., Massillon, Ohio.
Merrimac Chemical Co., 148 State Street, Boston, Mass.
Metropolitan Utilities District, Omaha, Nebr.
Norton Co., Worcester, Mass. (also Niagara Falls, N. Y.).
Passaic Valley Water Commission, 141 Ellison Street, Paterson, N. J.
Pennsylvania Salt Manufacturing Co., Widener Building, Philadelphia, Pa.
Sacramento Filtration Works, Sacramento, Calif.
Stauffer Chemical Co., 624 California Street, San Francisco, Calif.
Vanadium Corporation of America, Bridgeville, Pa.
Water Department of Kansas City, Kansas City, Mo.
Westvaco Chlorine Products, Inc., Carteret, N. J.

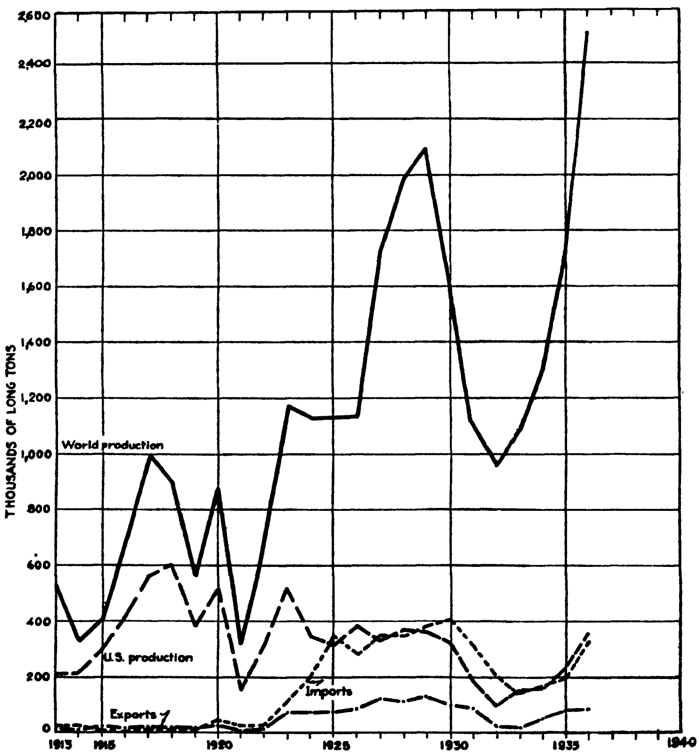


FIGURE 88.—Trends in domestic and world bauxite production compared with United States imports and exports, 1913–36.

PRICES

The largest consumers of bauxite in the United States own their own deposits, and other consumers usually contract in advance for their supply of bauxite. The market for new production is small, and prices vary widely. Domestic producers reported sales of bauxite during 1936 at prices ranging from \$4.98 to \$11.56 per long ton. The average value for Arkansas bauxite was \$5.89 per ton, for Alabama and Georgia \$6.41, and for the United States \$5.91. Quoted prices for bauxite in 1936, according to Engineering and Mining Journal Metal and Mineral Markets, were as follows: Domestic—chemical ore, crushed and dried, 55 to 58 percent Al_2O_3 and 1.5 to 2.5 percent Fe_2O_3, \$6 to \$7.50 a long ton f. o. b. Alabama and Arkansas mines; foreign—Dalmatian, 50 to 55 percent Al_2O_3 and 1 to 3 percent SiO_2, \$4.50 to \$6 per metric ton c. i. f. Atlantic ports; Istrian, 54 to 57 percent Al_2O_3 and 3 to 5 percent SiO_2, \$5.50 to \$6; and French, 56 to 59 percent Al_2O_3 and 2 to 4 percent SiO_2, \$5.50 to \$6.50.

FOREIGN TRADE

Bauxite imports in 1936 increased 61 percent while exports gained only 2 percent compared with 1935. The 1936 imports originated as follows: Surinam, 217,359 long tons; British Guiana, 91,193; Yugoslavia, 7,150; France, 6,985; and British India, 103.

Bauxite exports do not represent a true comparison to bauxite imports because they consist chiefly of calcined bauxite and alumina instead of crude ore. Of the 1936 exports classified as bauxite and other aluminum ores (56,227 long tons total), 56,226 tons went to Canada and 1 ton to Trinidad and Tobago; exports classified as bauxite concentrates, including alumina (28,244 long tons total), were consigned as follows: Canada, 19,681 long tons; Norway, 4,117; Italy, 3,739; Sweden, 704; and China, 3.

The total supply of bauxite, domestic production plus excess of imports over exports, totaled 610,324 long tons compared with 351,380 tons in 1935.

Bauxite imported into and exported from the United States, 1932–36

Year	Imports for consumption		Exports (including bauxite concentrates)		Year	Imports for consumption		Exports (including bauxite concentrates)	
	Long tons	Value	Long tons	Value		Long tons	Value	Long tons	Value
1932	205,620	\$1,042,829	28,474	\$1,162,238	1935	199,959	\$1,448,592	82,491	\$2,191,167
1933	149,548	899,696	21,760	645,688	1936	322,790	2,370,778	84,471	2,322,915
1934	166,653	1,201,710	51,415	1,039,955					

ALUMINUM

PRODUCTION

New aluminum produced in the United States during 1936 increased 89 percent in quantity and value over 1935. Secondary aluminum output amounted to 103,000,000 pounds in 1936, only a slight increase over 1935, according to J. P. Dunlop of the Bureau of Mines. The production of secondary aluminum was equivalent to 46 percent of

the primary output in 1936. Of the primary aluminum produced in 1936, 41 percent was made at Massena, N. Y.; 30 percent at Alcoa, Tenn.; 19 percent at Badin, N. C.; and 10 percent at Niagara Falls, N. Y. The aluminum-reduction plant at Niagara Falls, closed since July 1931, resumed operations in January 1936.

Aluminum produced in the United States, 1932–36

Year	Primary metal		Secondary metal		Year	Primary metal		Secondary metal	
	Pounds	Value	Pounds	Value [1]		Pounds	Value	Pounds	Value [1]
1932	[2] 104,888,000	$20,453,000	48,000,000	$10,992,000	1935	119,295,000	$22,070,000	102,800,000	$19,018,000
1933	[2] 85,125,000	16,174,000	67,000,000	15,343,000	1936	224,929,000	41,612,000	103,000,000	19,055,000
1934	74,177,000	14,094,000	92,800,000	17,632,000					

[1] 1932–33: Based on average price of 22.9 cents a pound; 1934–36: Based on average price as reported to Bureau of Mines.
[2] Revised figures.

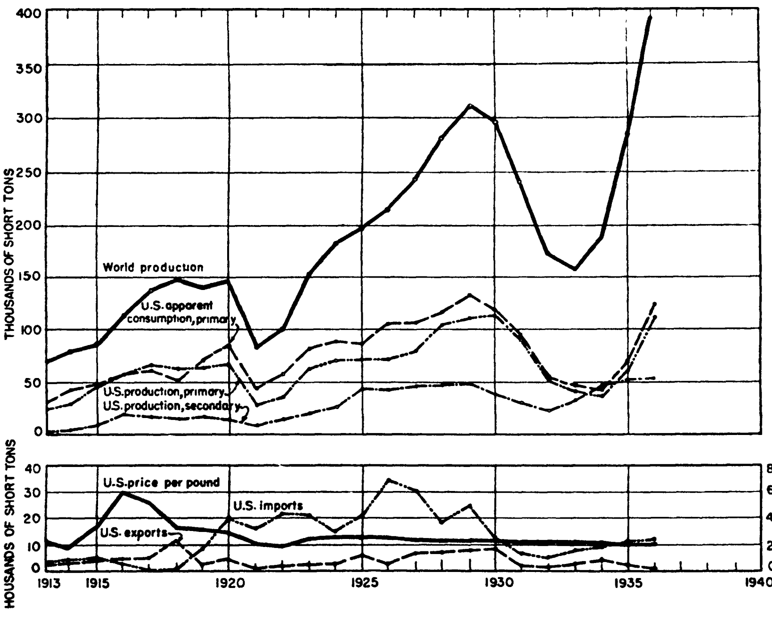


FIGURE 39.—Domestic and world primary aluminum production compared with domestic imports and exports of crude and semicrude, apparent consumption, secondary production, and average New York quoted price, 1913–36. Price is No. 1 virgin 98–99 percent through 1929, thereafter 99 percent plus virgin ingot, as reported by American Metal Market.

CONSUMPTION

The following table shows apparent consumption of primary aluminum in the United States from 1929 to 1936, inclusive. As the table does not consider fluctuations in producers' and consumers' stocks, it does not show actual consumption for any given year. During the first years of the depression there was a considerable accumulation of stocks at producers' plants. During the past 3 years withdrawals from these stocks have been as follows: 1934, 26,079 short tons; 1935, 27,515 tons; and 1936, 13,279 tons. The addition of these tonnages to the apparent consumption shown in the table would more accu-

rately reflect actual consumption of primary aluminum during 1934, 1935, and 1936.

Virtually all secondary metal is consumed as soon as it is gathered in the scrap market. From 1929 to 1936 secondary aluminum production was equivalent to 48 percent of the apparent consumption of primary metal.

Aluminum available for consumption in the United States, 1929–36, in short tons

	1929	1930	1931	1932	1933	1934	1935	1936
Primary aluminum:								
Production	[1] 113,987	[1] 114,519	[1] 88,773	[1] 52,444	[1] 42,563	37,089	59,648	112,465
Imports for consumption [2]	25,440	12,731	7,416	4,092	7,623	9,296	10,646	12,781
	139,427	127,250	96,189	56,536	50,186	46,385	70,294	125,246
Exports [2]	8,516	8,665	2,350	2,218	2,854	4,183	1,985	803
Apparent consumption	130,911	118,585	93,839	54,318	47,332	42,202	68,309	124,443
Secondary aluminum production	48,400	38,600	30,300	24,000	33,500	46,400	51,400	51,500

[1] Revised figures.
[2] Crude and semicrude, some of which may be secondary aluminum.

Increased consumption of aluminum in 1936 was due to the general improvement in industrial activity, which increased demand in well-established uses, as well as to new uses which have been developed, particularly in products where strength is a controlling factor. Among the latter was the use of aluminum in the construction of an emergency bulkhead for a roller-gate dam at Gallipolis, Ohio, where seven 28-ton units were installed. The metal was also used in construction of bulkheads for windows at a Pittsburgh store to serve as a protection against flood waters. Following the completion of the record-size 32-cubic-yard shovel dipper over a year ago, aluminum has been used in other excavating and loading equipment. Substitution of aluminum in cargo buckets has permitted 60 loads to be made per hour from the hold of a steamer in place of 40 with old-style equipment. A 25,000-pound aluminum grab bucket was developed at Duluth because of its resistance to corrosion from sulphur in the sulphur-bearing coal. The first aluminum dredge-boom, the longest ever made in any metal, was placed in service during the past year. Its total length is 240 feet; of this the inner 90 feet is steel and the outer 150 feet aluminum, Because the outer end of the boom is so much lighter, a 6-cubic-yard bucket was substituted for one with 4-cubic-yard capacity.

An aluminum bridge-floor system was installed on the Stratford Avenue Bridge in Bridgeport, Conn. The new marsh buggy for travel on land or water, used to prospect oil regions in swamps and bayous, is built of this light metal. The brewing industry is now using aluminum tanks for fermentation and storage. Aluminum beer barrels are lighter than wood, have a larger capacity, and can be stored in less space; the ordinary container weighs 70 pounds empty and holds 13 gallons, while an aluminum barrel weighs 18 pounds and holds 15½ gallons. Aluminum bottle caps and seals, are employed in great quantities.

The use of aluminum paint as a protective coating has doubled since 1929. Three of the largest bridges, besides hundreds of smaller ones, were painted with aluminum paint during the past year. The three large bridges were: Tri-Borough and George Washington,

New York; and the San Francisco-Oakland Bay Bridge, California. The latter used more than 50,000 gallons of aluminum paint as the final coat. Aluminum foil was used as insulation in refrigerator cars and trucks in 1936. A few of the many other newer uses of aluminum include lighting reflectors, license plates, windows for home construction, and a new pigment for lithographing packages.

PRICES

According to the American Metal Market the average price for 99-percent-plus pure virgin ingot aluminum, delivered, based on open market quotations in New York, remained at 20.50 cents a pound throughout 1936. Quotations ranged from 19 to 22 cents, with no explanation of the 3-cent spread. On March 1, 1937, the quotation was changed to 20 cents for carload lots with ½ cent premium for smaller lots down to 1 ton, and a 1-cent premium for less than ton lots. The increase of 1 cent on minimum quotations was attributed to increased costs of production.

FOREIGN TRADE

Foreign trade in unmanufactured aluminum in 1936 showed a substantial increase in imports and a sharp decline in exports. The quantity of crude and semicrude metal imported in 1936 was 20 percent more than in 1935, whereas exports declined 60 percent. Net imports of crude and semicrude aluminum accounted for 10 percent of the apparent consumption of primary metal in 1936. Imports of aluminum manufactures increased 74 percent in value, and exports declined 11 percent.

Aluminum imported for consumption in the United States, 1934–36, by classes

Class	1934		1935		1936	
	Pounds	Value	Pounds	Value	Pounds	Value
Crude and semicrude:						
Crude form, scrap, alloy, etc.	18,371,690	$3,561,833	21,075,683	$3,645,704	25,158,541	$4,072,634
Plates, sheets, bars, rods, circles, squares, etc.	219,901	62,700	215,552	48,634	404,030	92,327
	18,591,591	3,624,533	21,291,235	3,694,338	25,562,571	4,164,961
Manufactures:						
Leaf (5½ by 5½ inches)	(1)	57,532	(1)	105,269	(1)	95,798
Powder in leaf (5½ by 5½ inches)	(2)	602	(2)	2,824	(2)	976
Bronze powder and powdered foil	250,055	96,598	277,979	99,300	478,043	173,780
Foil less than 0.006 inch thick	504,415	167,952	944,330	293,094	1,879,389	655,477
Table, kitchen, and hospital utensils, and other similar hollow ware	96,688	56,910	81,549	51,226	77,509	46,805
Other manufactures	(3)	34,247	(3)	32,963	(3)	43,467
	(3)	413,841	(3)	584,676	(3)	1,016,303
Grand total	(3)	4,038,374	(3)	4,279,014	(3)	5,181,264

[1] 1934: 24,905,941 leaves; 1935: 41,298,561 leaves; 1936: 43,260,596 leaves; equivalent in pounds not recorded.
[2] 1934: 117,066 leaves; 1935: 644,025 leaves; 1936: 177,916 leaves; equivalent in pounds not recorded.
[3] Quantity not recorded.

Aluminum exported from the United States, 1934–36, by classes

Class	1934		1935		1936	
	Pounds	Value	Pounds	Value	Pounds	Value
Crude and semicrude:						
Ingots, scrap, and alloys	8,052,548	$1,141,808	3,361,097	$485,940	953,546	$129,808
Plates, sheets, bars, strips, and rods	313,009	107,256	609,250	208,432	652,207	252,016
	8,365,557	1,249,064	3,970,347	694,372	1,605,753	381,824
Manufactures:						
Tubes, moldings, castings, and other shapes	513,847	208,397	949,329	349,884	901,584	318,287
Table, kitchen, and hospital utensils	(1)	297,056	(1)	302,152	554,961	301,051
Other manufactures of aluminum	(1)	624,808	(1)	720,822	(1)	608,166
	(1)	1,130,261	(1)	1,372,858	(1)	1,227,504
Grand total	(1)	2,379,325	(1)	2,067,230	(1)	1,609,328

[1] Quantity not recorded for table, kitchen, and hospital utensils in 1934–35 and for other manufactures in 1934–36.

TECHNOLOGIC DEVELOPMENTS

Only minor improvements were made in the metallurgy of aluminum in the United States in 1936. In Europe a saving in cost of $4 or more per ton of alumina is said to have been accomplished by substitution of continuous-pressure apparatus for decomposing bauxite with alkali in place of the intermittent autoclave method now used in the Bayer process.[4]

The production of aluminum sheet, down to 0.120 inch in thickness, by direct rolling from molten aluminum has been announced by the Crown Cork & Seal Co., of Baltimore, by use of the Hazelett mill.[5] The sheets will be annealed and rolled to produce aluminum foil for use as "spots" in the crown cork. Direct-rolled molten steel is also to be developed. The company is also producing hot-dip aluminum-coated steel sheet for making crown tops and various containers, which is said to be superior to tin plate.

Many technologic advances have been made in treating aluminum against corrosion. One of the principal methods is the application of a resistent oxide coating. The Alumilite and Alzak anodizing processes for oxide coatings are used chiefly in this country.

Improvements in welding aluminum and its alloys have been recorded by Hoglund.[6]

Several recent articles[7] describe progress in the manufacture of aluminum alloys.

The United States Bureau of Mines is studying the problem of recovering potash and alumina from the alunites of the West, principally in Utah and within short distances from Boulder Dam. The study,

[4] Industrial and Engineering Chemistry, vol. 28, no. 37, Nov. 10, 1936, p. 435.
[5] Lippert, T. W., Direct-Rolled Aluminum: Iron Age, vol. 138, no. 16, Oct. 15, 1936, pp. 26–30, 33, 46.
[6] Hoglund, G. O., Advances Made in Welding Aluminum: Iron Age, vol. 137, no. 12, Mar. 19, 1936.
[7] von Zeerleder, Alfred, The Technology of Aluminum and Its Light Alloys (translated into English from the second German edition by A. J. Field).
American Society of Civil Engineers, Structural Application of Steel and Light-Weight Alloys, A Symposium: Proc., vol. 62, no. 8, pt. 1, October 1936.
Abstract Bulletin, Aluminium Ltd., Geneva.
Edwards, J. D., and Zeffries, Zay, Aluminum and Aluminum Alloys: Handbook of Engineering Fundamentals (by Eshbach, Ovid W.), 1936, pt. 11, pp. 58–70.
American Society for Metals, Metals Handbook, Cleveland, 1936.
Woldman, N. E., and Dornblatt, A. J., Engineering Alloys: Am. Soc. Metals, Cleveland, 1936.
Fink, Wm. L., Aluminum and Its Alloys: Ind. and Eng. Chem., vol. 28, no. 12, December 1936, pp. 1402–1406.

which is still in the preliminary stage, has been described by Knickerbocker and Koster.[8]

A part of the expansion program of the Aluminum Co. of America for 1937 provides for the construction of a large plant at La Fayette, Ind., for the manufacture of extruded shapes and tubing.

WORLD BAUXITE AND ALUMINUM INDUSTRIES

BAUXITE PRODUCTION

The estimated 1936 world production of bauxite is 2,600,000 metric tons compared with 1,744,000 tons in 1935, an increase of nearly 50 percent. This large increase in output resulted from the comparatively new production in Netherland India and increased activity in all countries, notably Hungary, Yugoslavia, France, United States, British Guiana, Surinam, Italy, and Greece. France contributed 29 percent of the 1935 bauxite output, United States 14 percent, Yugoslavia and Hungary each 12 percent, Italy 10 percent, U. S. S. R. (Russia) 8 percent, and British Guiana and Surinam each 6 percent.

World production of bauxite, 1932–36, by countries, in metric tons

[Compiled by M. T. Latus]

Country	1932	1933	1934	1935	1936
Australia:					
New South Wales		333	161	111	(1)
Victoria	1,147	681	970	1,064	(1)
British Guiana	(2) 63,510	(2) 36,663	(2) 51,417	(2) 113,290	212,681
France	401,430	490,500	528,400	512,800	648,500
Germany	1,638	1,727	6,560	8,547	(1)
Greece	590			9,489	(1)
Hungary	111,558	72,425	184,991	211,079	329,000
India, British	4,539	1,092	18	7,758	(1)
Italy	86,553	94,818	131,266	170,064	314,870
Netherland India				9,923	(1)
Portuguese East Africa				30	(1)
Rumania	612	1,156	1,458	1,473	(1)
Spain	1,300	2,500		(1)	(1)
Surinam (Dutch Guiana)	126,513	103,977	103,338	112,682	(1)
U. S. S. R. (Russia)	37,400	50,600	61,000	132,000	(1)
United Kingdom: Northern Ireland	1,497	709	58		(1)
United States	97,895	156,651	160,371	237,666	377,976
Yugoslavia	67,086	80,855	84,828	216,197	292,174
	1,003,000	1,095,000	1,315,000	1,744,000	(3) 2,600,000

(1) Data not available.
(2) Exports.
(3) Estimate.

ALUMINUM PRODUCTION

The world output of aluminum in 1936 was approximately 357,600 metric tons compared with 259,300 tons in 1935, an increase of 38 percent. The United States produced 29 percent of the 1936 total, Germany 27 percent, U. S. S. R. (Russia) 8 percent, Canada 8 percent, France 7 percent, United Kingdom 6 percent, Italy 5 percent, and Switzerland and Norway each 4 percent. The United States and Germany showed the largest increases in tonnage.

[8] Knickerbocker, R. G., and Koster, J., Electrometallurgical Studies of the Treatment of Alunite; Progress Reports—Metallurgical Division, No. 13, Electrometallurgical Investigations: Report of Investigations 3322, Bureau of Mines, 1936, pp. 36–64.

World production of aluminum, 1932–36, by countries, in metric tons

[Compiled by R. B. Miller]

Country	1932	1933	1934	1935	1936
Austria	2,100	2,000	2,100	2,200	1,300
Canada	17,800	16,200	15,800	21,500	26,900
France	14,400	14,500	16,300	22,000	26,500
Germany	19,300	18,900	37,200	69,300	95,200
Hungary				600	600
Italy	13,400	12,100	12,900	15,100	16,300
Japan			700	4,000	5,000
Norway	17,800	15,400	15,300	15,000	15,100
Spain	1,200	1,200	1,200	1,200	(1)
Sweden			300	1,800	(1)
Switzerland	8,500	7,500	8,100	11,800	15,700
U. S. S. R. (Russia)	1,000	4,400	14,400	25,500	30,000
United Kingdom	10,200	11,000	12,900	15,200	20,000
United States	47,600	38,600	33,600	54,100	102,000
	153,300	141,800	170,800	259,300	357,600

[1] Data not available. Estimate included in total.

ALUMINUM CONSUMPTION

World consumption of aluminum in 1935, the latest year for which figures are available, has been estimated by Metallgesellschaft at 307,000 metric tons. The principal consumers and the percentage of the total each accounted for were: United States, 28.5; Germany, 28.3; United Kingdom, 9.3; U. S. S. R. (Russia), 8.1; France, 7.8; Italy, 4.9; Japan, 4.1; Switzerland, 2.3; and Canada, 1.7. Europe accounted for 64.7 percent of the total world consumption.

REVIEW BY COUNTRIES

Australia.—The British Aluminium (Australia) Proprietary, Ltd., was recently formed to produce aluminum, with Risdon, Tasmania, rumored as the site for the works. The source of bauxite supply has not been determined, but small deposits occur in the Gippsland district of Victoria; in the Emmaville, Wingello, and Inverell districts of New South Wales; and in Queensland.

Brazil.—Bauxite occurs in Minas Geraes, São Paulo, Espirito Santo, Goyaz, Bahia, and the Para River district, Brazil. Exports of bauxite in 1936 were 7,000 metric tons. Of this quantity, the Companhia Geral de Minas shipped 4,000 tons from its deposits near Pocos de Caldas in Minas Geraes and São Paulo to Argentina for the production of aluminum sulphate. Ore from this vicinity runs about 60 percent Al_2O_3, 2 percent SiO_2, and 4 percent Fe_2O_3. Bauxite at Saremenha, near Ouro Preto, Minas Geraes, is under exploitation by the Companhia Electro-Chimica Brazileira.

British Guiana.—Much of the ore mined by Demerara Bauxite Co., Ltd., in British Guiana is now shipped directly to the new Arvida alumina plant of the Aluminum Co. of Canada, Ltd., whereas most of it formerly was processed at East St. Louis.[9]

Canada.—Bauxite imports into Canada increased from 115,490 metric tons in 1935 to 155,506 in 1936. Shipments from the United States and the United Kingdom consist largely of calcined bauxite and alumina.

[9] Harder, E. C., British Guiana and Its Bauxite Resources: Canadian Inst. Min. and Met., 1936, pp. 739–758.

The increase in bauxite imports is due chiefly to the fact that the Aluminum Co. of Canada, Ltd., a subsidiary of Aluminium, Ltd., began to convert British Guiana crude bauxite into alumina by the Bayer process at its Arvida plant in March 1936. Until the erection of this new alumina plant, most of the alumina was imported from the United States. Aluminum-reduction works using the Hall process are located at Arvida and Shawinigan Falls. The Shawinigan Falls reduction plant had been shut down but resumed operations in August 1936. The metal is fabricated at the company plants in Toronto and Shawinigan Falls.

France.—The large bauxite deposits of France are operated by French, Swiss, and British interests. The Cie de Products Chimiques et Électrométallurgiques Alais, Froges et Camargue (Péchiney) operates three alumina and eight aluminum-reduction plants in the Alps and in the Pyrenees, while the Sté. d'Électrochimie, d'Électrométallurgie et des Aciéries Électriques d'Ugine owns one alumina and three aluminum-reduction works. The sales organization for both companies is the Sté. L'Aluminium Français. Construction of a new aluminum works is reported at Pond-de-Lescun, Basses-Pyrenees, by a subsidiary of the Société des Forces Mortrices du Bern.[10]

A new process for the electrolytic refining of aluminum was put into operation by Péchiney at the St. Jean de Maurienne plant. The electrolyte, with a fusion point below 750° C., consists of 23 percent aluminum fluoride, 17 percent sodium fluoride, and 60 percent barium chloride and is claimed to reduce refractory costs and produce a metal with superior electrical conductivity and corrosion resistance.[11]

Exportation of bauxite, alumina, or aluminum from France is controlled by a Government licensing system.

Germany.—The aluminum industry of Germany imports its bauxite; and in 1936 imports totaled 981,162 metric tons, derived principally from Hungary, Yugoslavia, Italy, and Netherland India. The German-controlled Bauxite Trust A. G. (Zurich) operates mines in Hungary, Yugoslavia, Italy, and Rumania and thus guarantees a supply from these sources.

In 1936 Germany's aluminum production was exceeded only by that of the United States. The German aluminum producers are: The State-owned Vereinigte Aluminiumwerke A. G., with plants at Hoyerswerda, Grevenbroich, and Toging, Aluminiumwerke G. m. b. H. at Bitterfeld in Sachsen, and the Swiss-owned L'Aluminium-Industrie A. G. (A. I. A. G.) at Rheinfelden in Baden. The Vereinigte Aluminiumwerke is to build a new alumina works at Schwandorf, Bavaria, and the A. I. A. G. has doubled alumina production at its Martinswerk plant. Coal-steam power supplies current for all the reduction works except the Toging and Rheinfelden plants, which use hydroelectric power.

Germany's spectacular rise in aluminum production and consumption is due to the rearmament program, with its demand for aircraft, automotive vehicles, and ships; its substitution of aluminum for other metals in order to become self-sufficient; and the effort to improve its foreign-trade balance by exports of aluminum goods.

Imports of the crude metal declined from 15,247 metric tons in 1935 to 4,258 in 1936, but exports of semimanufactured and manufactured goods, especially aluminum foil, increased. A new German-

[10] Bureau of Foreign and Domestic Commerce, Foreign Metals and Minerals: Circ. 11, Jan. 29, 1937, p. 14.

[11] Queensland Government Mining Journal, vol. 37, no. 438, November, 1936, p. 378.

Scandinavian agreement permits Germany to export finished aluminum wares to Norway, Sweden, and Denmark as hitherto but does not allow her to increase sales in this market. The German industry wins the right to export unlimited quantities of raw and semifinished aluminum, but the Scandinavian industry reserves the expanding aluminum-ware market.

Gold Coast Colony.—Some of the largest and richest bauxite deposits lie along the equatorial belt of West Africa, although Africa has not as yet produced any bauxite. Anderson estimates a reserve of 180 million tons of good bauxite in the Yenahin district, about 45 miles west of Kumasi.[12] Some of the rich deposits at Mount Supirri in the Affoh group near Sefwai-Bekwai carry gold and silver in and beneath the laterite capping.[13] Other Gold Coast deposits are at Mount Ejuanema near Nkawkaw, Kwahu, and at Nsisreso, Asempanaiye, N. W. Sefwi. The ore ranges from 49 to 55 percent Al_2O_3, 0.2 to 2 percent SiO_2, and 13 to 25 percent Fe_2O_3.

Other Africa.—Other large bauxite deposits are found in Africa on the Lichenya Plateau in Nyasaland and in the Atlas Mountains of French Morocco, while deposits are reported in French Guinea, Sierra Leone, Tanganyika Territory, Madagascar, and Abyssinia.

Greece.—Although bauxite shipments totaled only 13,150 metric tons in 1935, the completion of mining and shipping improvements in Greece will permit an annual exportation of over 100,000 tons. The two principal producers are the Bauxites-Parnasse S. A., operating on the mainland of the north shore of the Gulf of Corinth, between Messolohgui and Thebes, and the Bauxites S. Papassotiriou, working a deposit on the Island of Amorgos adjacent to the Ægean Sea. Bauxite from the Itea area runs about 60 percent Al_2O_3, 3 percent TiO_2, 2 percent SiO_2, and 22 percent Fe_2O_3. Open-pit mining and the proximity of some of the mines to navigable water enable operators to deliver crude bauxite at the docks for $1.03 to $1.60 per long ton. The 1936 exports were chiefly to Germany, United Kingdom, Japan, and Norway.

Hungary.—Most of the bauxite output comes from the Gânt deposits in western Hungary. Work has started on a new bauxite discovery in the Nagyharsâny Mountains, Baranya County, southern Hungary. Although much of the bauxite is exported, particularly to Germany, Hungary has its own aluminum industry capable of supplying domestic consumption. Bauxite Industry, Ltd. (Budapest), produces alumina at Magyaróvár (Altenburg), and the aluminum-reduction works of the Aluminiumwerke Manfred Weiss A. G. (Budapest) is located at Csepel. Aluminum output is to be increased and aluminum cables and wires are to be produced.

India (British).—A recent publication describes the possibility of producing aluminum in Bombay, India.[14] Most of the small output heretofore has come from the Jabalpur district, Central Provinces, and the Khaira District.

Italy.—The Istria district produces most of Italy's bauxite output. A new deposit was discovered recently in the Aidussina district near Gorizia. Large deposits of leucite, as well as some aluminite, occur in the old volcanic regions of central Italy.

[12] Anderson, Robert J., World Resources of Aluminum Ore: Mining Mag. (London), vol. 55, no. 6. December 1936, pp. 329–341.

[13] Cooper, W. G. G., Gold Coast Bauxite: Bull. Imperial Inst., vol. 34, no. 3, July-September 1936, pp. 331–347; Gold Coast Geol. Survey, Bull. 7, 1936.

[14] Patel, M. S., Possibility of Production of Aluminium in Bombay: Dept. of Industries, Bombay, Bull. 10, 1936, 27 pp.

In 1936 the Italian aluminum industry built additional plants and enlarged others. The Montecatini group controls the new alumina plant using the Bayer process and another using the Haglund process at Porto Marghera, and two aluminum-reduction works, one at Mori, which is being enlarged, and a new one at Bolzano. The Swiss-owned Società Anonima Veneta Alluminio owns an alumina plant at Bussi, and a new one is under construction at Porto Marghera. Its aluminum-reduction works at Porto Marghera, which has accounted for about half of the Italian output, is to be enlarged and an aluminum powder plant added. The Canadian-controlled Borgofranco d'Ivrea reduction works plans to increase its present annual capacity of 1,500 tons. Upon completion of all new construction, Italy's production capacity will be 60,000 tons of alumina and 30,000 tons of aluminum. This expansion will permit Italy to enlarge its aluminum exports, although a Government licensing system controls the exportation of bauxite and aluminum and its alloys.

Japan.—Bauxite is not found in Japan but is imported principally from Netherland India and Greece. Attempts are being made to produce alumina from Manchurian shale and Korean alunite, but some producers have not found this domestic raw material satisfactory and are now using imported bauxite.

Long dependent on foreign sources for aluminum, chiefly from Canada, Norway, Switzerland, and France, Japan began to develop its own aluminum industry in 1933. Aluminum works, some of which are still in the experimental stage and others which are proposed, include: The Japan Electric Industry Co.; Japan Aluminium Co. at Takao, Formosa; Nichiman Aluminium Co., also called the Japan-Manchoukuo Aluminium Co.; Aluminium Manufacturing Co., a subsidiary of the South Manchuria Railway Co., with a plant proposed in the coal fields at Fushun; Sumitomo Metal Industry Co. at Osaka; and the Korean Nitrogen Fertilizer Co. at Tumen, Manchuria.

Much of the domestic product has been considered of poor quality, due principally to the use of alunite instead of bauxite for raw material. To protect the domestic industry, an increase in the tariff on imported aluminum became effective in June 1936.

Netherlands.—A proposed aluminum works to be built in the vicinity of the Limburg coal field would utilize bauxite from the mines on the island of Bintang, Netherland India.

Netherland India.—The islands of Bintang and Batam in the Dutch East Indies are becoming large producers of bauxite. Production increased to considerably more than 100,000 tons in 1936, compared with 9,923 tons in 1935. Exports are chiefly to Germany, Netherlands, and Japan. Exploitation is by the Nederlandsch-Indische Bauxiet Exploitatie Maatschappij (subsidiary of the Billiton Tin Co.). The deposits are about 12 feet thick, and the ore contains approximately 53 percent Al_2O_3, 2.5 percent SiO_2, 13.5 percent Fe_2O_3, and 1.2 percent TiO_2.

Norway.—Aluminum-reduction plants owned by British, Canadian, and French aluminum interests are located at Eydehavn, Stangfjord, Vigeland, Tyssedal, Glomfjord, and Höyanger, Norway. The Norsk Aluminium Co. at Höyanger, owned jointly by Norwegian interests and Aluminium, Ltd., is the only concern with a plant to refine bauxite into alumina. It uses the Pedersen process and produces about 14,000 tons of alumina and 4,000 tons of crude iron annually as a

byproduct. The other plants import their alumina and export the metal produced.

In 1936 imports of bauxite totaled 24,046 metric tons (32,570 in 1935) and of alumina 23,019 tons (19,455 in 1935). Norwegian exports of crude aluminum aggregated 15,087 tons in 1936, much of which went to the United States and Germany.

Rumania.—Rumania contains large bauxite deposits in the Bihar Mountains which are exploited by the Aurum Mining Co. Erection of an aluminum works at Targoviste is under consideration.

Surinam (Dutch Guiana).—Virtually all the bauxite produced by the Surinaamsche Bauxite Maatschappij, a subsidiary of the Aluminum Co. of America, at Moengo is shipped to East St. Louis for refining into alumina. The deposits are 10 to 18 feet thick and contain about 59 percent alumina, 2 percent silica, and 6 percent ferric oxide.

The Dutch Guiana and British Guiana bauxite deposits, which occur along a belt more or less parallel to the coast, are said to extend into French Guiana and Brazil and also into Venezuela.

Switzerland.—The oldest aluminum-producing company in Europe, founded in 1889, is L'Aluminium Industrie-Aktien-Gesellschaft (A. I. A. G. or Neuhausen Co.). Its Swiss reduction plants are at Neuhausen, Canton Schaffhausen, and Chippis, Canton Valais. Raw materials are supplied by affiliated mines and plants in France, Germany, Italy, and Rumania. Affiliated aluminum-production works are at Rheinfelden, Germany; Bussi and Porto Marghera, Italy; and Lend, Austria. The Fabrique d'Aluminium Martigny, S. A., with 1,260 tons annual production, is an independent producer at Martigny-Bourg, Canton Valais. The A. I. A. G. is one of the chief promoters of the world aluminum cartel, the Alliance Aluminium Cie. (Basel), with which most of the leading world aluminum producers, except the United States, are associated.

United Kingdom.—The British Aluminium Co., Ltd., and the Aluminium Corporation, Ltd., together produce the aluminum output of the United Kingdom. Large quantities of aluminum and aluminum alloys are imported from Canada (15,423 metric tons in 1935 and 16,925 tons in 1936) and smaller amounts from Switzerland and Norway.

U. S. S. R. (Russia).—Bauxite deposits occur in the Leningrad district near Tikhvin, northwestern U. S. S. R., in the Sverdlovsk and Chelyabinsk districts of the Ural Mountains, and in the undeveloped Belovo region in western Siberia. The Ural deposits are larger and of better grade (36 to 50 percent alumina and 3.7 to 5.3 percent silica) than those at Tikhvin (44 percent alumina and 12 to 15 percent silica). Other possible raw material sources are nepheline from Karelia (Kola Peninsula) and leucite from Armenia.

Alumina works include the plants at Volkhov (Svanka), Tikhvin, and Neproges (Dnepr or Zaporozhe plant), while another is under construction at Kamensk and still another is contemplated at Kandalaksha in Karelia for the treatment of nepheline. There is an experimental alumina plant at Korov-Abad, near Tbilisi (Tiflis). Aluminum-reduction plants include the Svanka and Dnepr, with the Kamensk nearing completion and construction reported to commence shortly on another in Karelia and later in Perm. Crude artificial cryolite is to be made at the Polevskoi plant in the Urals from fluorspar obtained from the Chita region of Eastern Siberia.

The Russian aluminum industry is due to the Government self-sufficiency program and not to economic raw-material resources. Much difficulty was experienced by the Aluminium Research Institute in working out complicated processes to produce alumina from the bauxite, which is low in alumina and high in silica. The long hauls of raw materials are being alleviated by the erection of alumina and reduction plants near the mines, but shipments of materials over long distances will still be necessary to the Dnepr plant in the Ukraine.

Yugoslavia.—Economic grades of bauxite occur at many places in Yugoslavia; but most of the output, largely exported, comes from the Drnis and Sinj districts of Dalmatia and from the Knez Polje and Ygrovac districts near Mostar in Herzegovina. Aluminium A. G. (Belgrade) has commenced construction of an aluminum works at Jaruga near Sibenik which will have an annual capacity of 1,000 tons of aluminum.

MERCURY

By H. M. Meyer

SUMMARY OUTLINE

The mercury industry in the United States in 1936 was characterized by a notable increase in demand, partly caused by fears concerning future supply; by lower domestic production in the face of a moderate rise in price that became substantial in the late months of the year; and by a sharp upswing in receipts of metal from foreign countries.

The continuation of civil strife in Spain, where the principal mercury reserves of the world are situated, together with increased demand for the metal in large mercury-consuming countries of Europe that are engaged in record-breaking armament preparations, continued to contribute to the tense international situation. The termination of the war between Italy and Ethiopia and the removal of sanctions against Italy, second in importance as a source of mercury, eased the situation somewhat, but it is extremely doubtful that Italy could supply the world demand for mercury even temporarily, should supplies from Spain be cut off entirely. Despite fears that Spanish production would cease, however, large quantities of metal are reported to have left that country late in 1936. The Government controlled the mines as the year ended, but some shipments were reported to have been intercepted by opposing troops.

Another event of utmost importance in the international mercury situation was the sudden breaking up of the cartel agreement between Spain and Italy. In forecasting this occurrence the Metal Bulletin of London [1] said:

> The Spanish civil war has also been directly responsible for another event of the greatest importance to the quicksilver market, namely the denunciation by the Almaden mines, presumably under Government pressure, of the Cartel agreement with Italy as a protest against alleged Italian deliveries of arms to the insurgents.

The dissolution of the mercury cartel would seem to herald a renewal in the not distant future of the keen competitive conditions that prevailed prior to its formation and lower prices for the metal, barring the destruction of the Almaden mine workings and reduction equipment or a lengthy extension of the civil war in Spain.

[1] Metal Bulletin, The Quicksilver Situation: No. 2133, Oct. 20, 1936, p. 8.

In the United States the maritime strike on the Pacific coast and unusually bad weather in the final quarter of 1936 contributed to the lack of supplies of domestic mercury at the end of the year in New York. In addition, larger amounts of metal were required for placer-gold operations in Western States, thus lowering the amount of mercury available for shipment. Some metal was reported shipped east by rail in the last months of the year.

Imports of mercury in 1936 were considerably more than twice those received in 1935, and more than one-half of the quantity imported entered the country in the last quarter of the year. Increased imports, together with a relatively small decline in domestic production, indicated that larger quantities of metal were available for consumption. Greater consumptive demand only partly explains the increased importation of metal during the year, however, as fears concerning future supplies are believed to have had an important bearing on the size of purchases. The international conditions already mentioned led importers to increase their purchases of Italian metal. More than one-half of the imports from Spain arrived in the first 6 months of 1936 whereas imports from Italy increased sharply as the year progressed, those in December alone being 41 percent higher than the quantity imported in the entire first 6 months of the year.

Salient statistics of the mercury industry in the United States, 1933–36

[Flasks of 76 pounds]

	1933	1934	1935	1936
Production ... flasks	9,669	15,445	17,518	16,569
Number of producing mines	75	93	90	87
Average price per flask:				
New York	$59.23	$73.87	$71.99	$79.92
London	$41.64	$56.15	$60.74	$64.33
Imports for consumption:				
Pounds	1,543,935	774,564	593,904	1,374,652
Equivalent flasks	20,315	10,192	7,815	18,088
Apparent new supply ... flasks	29,700	25,400	25,200	34,400
From domestic mines ... percent	32	60	69	47
Stocks in warehouses (bonded) at end of year ... flasks	5,370	4,346	3,582	2,513

Prices.—The average quoted price for mercury in New York was relatively stationary at approximately $77 a flask for the first 4 months of the year. The monthly average dropped in May and continued downward until the low average of the year, $73.42 a flask, was reached in July. Declining receipts of metal from Spain and Italy in the third quarter of the year caused a sharp upswing in prices in September, which continued throughout the final quarter of the year. Whereas the highest monthly average for the year was $90.25 for November and December, little metal was available for sale, and trade reports were that $95 or more would be required to buy metal in any quantity. There were appreciable differences between the prices quoted in London by the cartel agents and those asked by independent merchants, although such discrepancies continued for only a short time. According to the Metal Bulletin, September 8, 1936, Roura & Forgas, the cartel agents at that time, stated that the Almaden mines had large stocks at Alicante and also at the mines. A large shipment was expected from Spain toward the end of September, against which the agents were selling at £12 17s. to £12 17s. 6d. ($64.72 to $64.84) a flask. London merchants at the

same time were selling from their stocks at £20 to £22 ($100.73 to $110.80) per flask.

Average monthly prices per flask (76 pounds) of mercury at New York and London and excess of New York price over London price, 1934–36

Month	1934			1935			1936		
	New York [1]	London [2]	Excess of New York over London	New York [1]	London [2]	Excess of New York over London	New York [1]	London [2]	Excess of New York over London
January	$67.54	$48.45	$19.09	$72.76	$58.71	$14.05	$76.77	$64.02	$12.75
February	72.01	53.14	18.87	72.50	58.48	14.02	77.00	63.01	13.99
March	75.47	54.76	20.71	72.50	58.75	13.75	77.00	64.10	12.90
April	75.93	55.40	20.53	72.50	59.86	12.64	76.73	62.40	14.33
May	75.58	55.21	20.37	72.14	59.87	12.27	74.94	61.81	13.13
June	75.00	57.80	17.20	71.46	61.93	9.53	74.19	62.05	12.14
July	75.00	57.19	17.81	70.54	61.60	8.94	73.42	60.96	12.46
August	75.00	58.12	16.88	69.00	61.50	7.50	73.92	61.57	12.35
September	74.56	57.93	16.63	69.21	60.40	8.81	85.28	64.97	20.31
October	74.00	58.67	15.33	71.75	62.57	9.18	89.24	67.23	22.01
November	73.28	58.62	14.66	74.35	61.68	12.67	90.25	69.65	20.60
December	73.00	58.11	14.89	75.20	63.58	11.62	90.25	69.94	20.31
Average	73.87	56.15	17.72	71.99	60.74	11.25	79.92	64.33	15.59

[1] Engineering and Mining Journal, New York.
[2] Mining Journal (London) prices in terms of pounds sterling converted to American money by using average rates of exchange recorded by the Federal Reserve Board.

Increased activity was evident at domestic mines in the latter part of 1936 as a result of the advance in price. Due to the time required to bring even a fully equipped idle mine into production, however, no increase in output was noted in 1936; in fact, production actually fell off somewhat. Should prices continue at their present levels some increase may be looked for in the near future.

Production at price.—A study of the record of production of domestic mines from 1910 to the present time brings out two facts clearly—increasingly higher prices are required to bring out a given production of mercury, and increased output is supplied by ores of diminishing grades.

In making this study, mercury index prices were used instead of actual quoted prices to reduce to a minimum the factors that would tend to distort the conclusions drawn. The mercury index price was obtained by dividing the quoted price by the Department of Labor wholesale price index for all commodities (1913=100). For the period 1910–26 quoted prices for 75-pound flasks were reduced to the equivalents for 76-pound flasks.

During the period covered by the table, demands for mercury fluctuated widely and prices moved similarly. When prices were high, larger proportions of the country's needs were supplied by metal of domestic origin. As the index price returned to a previous level, however, less metal was produced than the output when the index formerly stood at the same level. Higher prices were necessary to bring forth an output similar to former records. There were minor disturbances of this trend due (1) to the exploitation of relatively small new deposits where higher-grade ores could be treated for a time at lower cost or (2) to the discovery of richer veins in properties already productive, but these only temporarily interrupted the major trend.

Index prices for mercury ranged from $40 to $51 from 1910 to 1914, and production from 16,330 to 24,734 flasks. Rapidly increasing

prices in 1915 and 1916 culminated in the highest index price for the period under discussion—$103.80 in 1916—which resulted in the peak output of 35,683 flasks in 1917. In the years 1922–25 the index price ranged from $43 to $57, but the resultant outputs varied from only 6,291 to 9,952 flasks. Increases that carried the price to $89 to $93 in 1928 to 1930 were sufficient only to bring out the recent high output of 24,947 flasks in 1931, about equal to the output of 1912 when the index stood at $43.

As the price increased and higher outputs were made the grade of ore declined. From 1913 to 1915 an annual average of 19,011 flasks of mercury was produced from ore with a recovered mercury content of 0.52 percent. In the years 1916–18, when the peak output in the period under discussion was made, the annual average production was 32,557 flasks, but was won from ores having a recovered tenor of only 0.39 percent. The average annual output from 1921 to 1927, when output was low, was 8,293 flasks, and the average recovered tenor of ore increased to 0.51 percent. The sharply higher production of 1928–31, an annual average of 22,013 flasks, came from ores containing only about 0.31 percent mercury.

Comparing the 7 years ended in 1936 with the two preceding 10-year periods, it is found that the average annual output of 24,188 flasks produced in 1910–19 was obtained from ores with a recovered mercury content of 0.47 percent, 11,282 flasks for 1920–29 from ores averaging 0.42 percent, and 16,903 flasks for 1930–36 from ores averaging 0.35 percent. In recent years virtually all dump material and earth from under old reduction plants have been excluded in calculating tenor of ores, but fairly substantial quantities were included in some of the years prior to 1920. This situation tends to accentuate the trends indicated above.

The average annual domestic consumption of mercury is probably 25,000 flasks or more. The index price of $93 a flask in 1930 resulted in an output of nearly 25,000 flasks in 1931, and nearly 72,000 flasks have been produced since 1931. From the preceding discussion it is clear that depletion of reserves results in smaller outputs as each price cycle returns to a previous level. A conclusion that might be drawn from this study is that an index price well above $93 a flask (equivalent at the December 1936 average for all commodities to an actual price of $112) would be needed to produce the desired amount for even 1 year. This price would apparently have to be raised at an accelerated rate to continue to draw the needed amount from domestic mines for even a limited period of time.

It is significant that the output of 24,734 flasks of mercury in 1912 was made by 20 mines, whereas that of 24,947 flasks in 1931 was made by 77 mines. In 1912 the two mines that have produced the largest quantities of mercury in the United States to date, the famous New Almaden and New Idria mines, and two other large properties, the Guadalupe mine, Santa Clara County, Calif., and Mercury mine, Nye County, Nev., contributed nearly 21,000 flasks to the total for the country. In 1931 these mines were either closed down or producing at a greatly reduced rate. No new mines have been discovered since 1912 with sufficient ore reserves to compensate for the loss of output from these properties. Consequently, it required a larger number of small properties in 1931 to produce—even at higher prices—as much mercury as in 1912.

Mercury produced in the United States, recovered tenor of ores treated, and average prices, 1910–36

	Number of mines	Recovered mercury content of ores treated [1] (percent)	Mercury produced (flasks of 76 lbs.)	Average price per flask at New York	
				Quoted	Index [2]
1910	19	0.63	20,330	[3] $47.69	$47.26
1911	25	.58	20,976	[3] 47.16	50.71
1912	20	.61	24,734	[3] 43.03	43.46
1913	24	.56	19,947	[3] 40.07	40.07
1914	30	.51	16,330	[3] 48.95	50.15
1915	39	.50	20,756	[3] 88.17	88.52
1916	66	.45	29,538	[3] 127.16	103.80
1917	51	.48	35,683	[3] 107.72	64.00
1918	47	.30	32,450	[3] 125.12	66.52
1919	34	.42	21,133	[3] 93.38	47.02
1920	17	.46	13,216	[3] 82.20	37.16
1921	11	.63	6,256	[3] 46.07	32.95
1922	10	.51	6,291	[3] 59.74	43.13
1923	14	.59	7,833	[3] 67.39	46.77
1924	13	.50	9,952	[3] 70.69	50.31
1925	13	.50	9,053	[3] 84.24	56.80
1926	17	.54	7,541	[3] 93.13	64.99
1927	26	.41	11,128	118.16	86.44
1928	54	.40	17,870	123.51	89.18
1929	63	.30	23,682	122.15	89.49
1930	76	.25	21,553	115.01	92.90
1931	77	.33	24,947	87.35	83.51
1932	95	.41	12,622	57.93	62.42
1933	75	.41	9,669	[illegible].23	62.74
1934	93	.41	15,445	73.87	68.84
1935	90	.43	17,518	71.99	62.82
1936	87	.39	16,569	79.92	69.02

[1] Prior to 1920 total tonnage treated (partly estimated), including material from old dumps, earth from beneath old reduction plants, etc., was used in calculating recovered tenor. From 1920 on old dump materials, etc., has been excluded, insofar as possible, and tenor calculated on all available data covering new ore treated. From 82 to 98 percent of the total mercury production was covered in calculating tenor for 1920–36.
[2] The mercury index price has been calculated for each year by dividing the New York quoted price of mercury by the Bureau of Labor Statistics wholesale price index for all commodities (1913=100).
[3] Quoted prices for 75-pound flasks calculated to the equivalents for 76-pound flasks.

As a result of frequent requests received by the United States Bureau of Mines for information on the treatment of mercury ores the Metallurgical Division has prepared a report entitled Occurrence and Treatment of Mercury Ore at Small Mines. The main theme of this report is treatment by furnacing, but concentration, mining of the ore, and precautions against mercury poisoning are covered. Copies of this report will be available later from the Publications Section, United States Bureau of Mines, Interior Building, Washington, D. C.

Consumption and uses.—During 1936 [2] the General Electric Co. installed a mercury boiler, a 1,000-kilowatt mercury turbine, a condenser-boiler making 12,500 pounds of steam per hour at 185 pounds pressure, and a 900-kilowatt steam turbine in each of its shops at Pittsfield and Lynn, Mass. These boilers require 6 pounds of mercury per kilowatt of capacity, less than is needed for the boilers at Schenectady, N. Y., and Kearney, N. J. Design sketches for a mercury-steam installation of 44,000-kilowatt capacity employing a single drum have been made by General Electric.

Continued experimentation with small mercury lights in 1936 was reported to have brought satisfactory results. Development of 85- and 100-watt bulbs, of smaller size but giving as much light as the standard filament 200-watt lamp, was reported. A small mercury-

[2] Power Plant Engineering, Mercury in Small Boilers: April 1937, p. 213.

break switch, silent in operation and without moving parts, was announced by the General Electric Co. and described as follows:[3]

The switch consists of two shallow chrome-steel cups, ¾-in. diameter, sealed together with a strip of lead glass to form a hollow compartment. Separating the cups is a disk of ceramic material having a small hole located near the edge. After assembly, this compartment is evacuated and four grams of mercury are inserted. This fills approximately one-quarter of the space. The compartment is then filled with hydrogen at about atmospheric pressure and sealed off by welding.

In the "off" position, the hole in the ceramic disk is above the mercury line. At rotation of 20 deg. the switch assumes a position which permits mercury to flow through the hole, thus establishing contact between the two chrome-steel cups, closing the circuit.

Hydrogen serves as a cooling agent and in quenching the arc. Heating is also controlled through a mercury-to-metal contact employing a mil of platinum on a tiny plate of steel, welded on the inside of each cup.

Prospects for increased consumption of mercury in new uses were summarized as follows:[4]

While counting heavily on the demand created by long-established uses, producers are watching hopefully these developments, among others: hardening of lead alloys containing alkali earths or metals by addition of quicksilver; substitution of quicksilver for tin in production of type-metal alloys; use of the metal in plating iron with lead; adaptation of mercury vapor as a high-temperature industrial heating medium; development of a device using mercury for elimination of scale and corrosion in radiators and cooling systems of automotive vehicles; use of metallic hair tints containing mercury by the cosmetic field; development of a tiny mercury lamp two inches long, thinner than a lead pencil, and emitting a 200-candlepower glare, which may replace the electric arc in movie projectors and is useful also in composing rooms and photographic studios; development of a new method of printing that may be a formidable rival of offset lithography, by which it is possible to print 200-line screen halftones on heavy-ribbed stock, even on sandpaper and textiles.

Increased quantities of mercury were required in 1936 for gold-mining operations in the Western States.

The following table shows the new supply of mercury in the United States, 1927–36:

Supply of mercury in the United States, 1927–36

[Flasks of 76 pounds]

Year	Production (flasks)	Imports for consumption (flasks)	Exports (flasks)	Apparent new supply: Total (flasks)	From domestic mines (percent)	Imported (percent)
1927	11,128	19,941	(1)	[2] 30,900	35.5	64.5
1928	17,870	14,562	(1)	[2] 32,300	54.9	45.1
1929	23,682	14,917	(1)	[2] 38,500	61.3	38.7
1930	21,553	3,725	(1)	[2] 25,200	85.2	14.8
1931	24,947	549	[3] 4,984	20,512	97.3	2.7
1932	12,622	3,886	[3] 214	16,294	76.2	23.8
1933	9,669	20,315	(1)	[2] 29,700	31.6	68.4
1934	15,445	10,192	(1)	[2] 25,400	59.9	40.1
1935	17,518	7,815	(1)	[2] 25,200	69.0	31.0
1936	16,569	18,088	263	34,400	47.4	52.6

[1] Not separately classified for 1927-30 and 1933-35.
[2] Estimated by Bureau of Mines.
[3] From a special compilation by the customs statistics section, Bureau of Foreign and Domestic Commerce.

[3] Iron Age, vol. 137, no. 10, Mar. 5, 1936, p. 53.
[4] Business Week, no. 361, Aug. 1, 1936, p. 20.

REVIEW BY STATES

The output of mercury in the United States in 1936 declined 5 percent from that in 1935 despite increased demand and prices. The decline was not evenly distributed over the country as a whole and output in some localities showed rather pronounced improvement. In the important producing areas increased output was made in Arkansas and Oregon, while production declined in California and Texas. The total number of producing properties was relatively stationary for the past 3 years, although there were changes in the actual mines producing, particularly among the smaller ones. The principal producing mines in 1936 were as follows: Arkansas: Pike County—mines of the Mid-Continent Quicksilver Co. and of the Mercury Mining Co.; California: Lake County—Sulphur Bank, Mirabel, and Great Western mines; Napa County—Oat Hill mine; San Benito County—New Idria mine (dumps); and San Luis Obispo County—Oceanic and Klau mines; Oregon: Jefferson County—Horse Heaven mine; Lane County—Black Butte mine; and Malheur County—Bretz and Opalite mines; Texas: Brewster County—Chisos and Rainbow properties. These properties produced 85 percent of the total domestic output of mercury in 1936.

The sharply increasing price for mercury in the latter part of 1936 is reported to have resulted in greater activity at producing mines and in the opening up of idle properties that formerly had produced. One operation that will be watched with particular interest is the reopening, under new ownership and management, of the mine workings of the New Idria mine in San Benito County, Calif. This famous old mine had been idle since 1931, except for the working of old dumps. Old mine workings are now being cleaned out, and one of the four rotary furnaces is being reconditioned for use.

Mercury produced in the United States, 1933–36

	Producing mines	Flasks of 76 pounds	Value [1]
1933			
California	49	3,930	$232,762
Nevada	12	387	22,921
Oregon	5	1,342	79,483
Texas, Arkansas, Washington, and Utah	9	4,010	237,500
	75	9,669	572,666
1934			
Arkansas	5	488	36,046
California	49	7,808	576,738
Nevada	18	300	22,160
Oregon	11	3,460	255,573
Washington	5	330	24,375
Texas and Arizona	5	3,059	225,953
	93	15,445	1,140,845

	Producing mines	Flasks of 76 pounds	Value [1]
1935			
Arkansas	6	304	$21,885
California	52	9,271	667,419
Nevada	13	190	13,678
Oregon	10	3,456	248,798
Washington	4	106	7,631
Texas and Arizona	5	4,191	301,710
	90	17,518	1,261,121
1936			
California	51	8,693	694,744
Nevada	11	211	16,863
Oregon	13	4,126	329,750
Utah	1	25	1,998
Arkansas, Texas, Arizona, and Washington	11	3,514	280,839
	87	16,569	1,324,194

[1] Value calculated at average price for quicksilver at New York.

EMPLOYMENT, MAN-HOURS, AND PRODUCTIVITY AT MINES AND PLANTS

The following table indicates the average number of men employed at mercury mines and plants, the time employed, and the approximate output per man-shift and per man-hour for the past 10 years. A short explanation of the trends indicated by the table is contained in the chapter of this series for 1936.

Employment at mercury mines and plants in the United States, mercury produced, and average output per man, 1926–35

Year	Employment									Production					
	Average number of men employed			Time employed						Total (flasks of 76 pounds)	Covered by study			Average pounds per man (mines and plants)	
				Man-shifts			Man-hours								
	Mines	Plants	Total	Mines	Plants	Total	Mines	Plants	Total		Flasks	Equivalent pounds	Percent of total	Per shift	Per hour
TOTAL UNITED STATES															
1926	283	30	313	89,606	8,175	97,781	716,848	65,400	782,248	7,541	6,559	498,484	87	5.10	0.64
1927	364	104	468	120,570	24,645	145,215	964,560	197,180	1,161,740	11,128	8,062	612,712	72	4.22	.53
1928	517	141	658	167,184	38,080	205,264	1,358,277	304,540	1,662,817	17,870	14,251	1,083,076	80	5.28	.65
1929	748	222	970	217,920	58,467	276,387	1,764,310	470,549	2,234,859	23,682	20,114	1,528,664	85	5.53	.68
1930	665	231	896	201,695	58,852	260,547	1,778,830	470,816	2,249,646	21,553	19,731	1,499,556	92	5.76	.67
1931	752	221	973	213,499	57,166	270,665	1,745,869	464,226	2,210,095	24,947	22,772	1,730,672	91	6.39	.78
1932	331	137	468	75,810	26,761	102,571	606,498	214,087	820,585	12,622	10,580	804,080	84	7.84	.98
1933	286	113	399	70,406	22,068	92,474	562,682	172,669	735,351	9,669	8,234	625,784	85	6.77	.85
1934	343	159	502	87,388	36,609	123,997	650,848	278,505	929,353	15,445	13,504	1,026,304	87	8.28	1.10
1935	365	186	551	96,910	44,070	140,980	725,260	354,714	1,079,974	17,518	15,421	1,171,996	88	8.31	1.09
CALIFORNIA															
1928	254	74	328	83,225	17,622	100,847	665,800	140,976	806,776	6,977	6,571	499,396	94	4.95	0.62
1929	419	134	553	116,413	29,316	145,729	931,304	235,088	1,166,392	10,139	9,214	700,264	91	4.81	.60
1930	335	150	485	98,820	33,862	132,682	790,560	270,896	1,061,456	11,451	10,791	820,116	94	6.18	.77
1931	396	136	532	105,710	31,420	137,130	846,497	256,105	1,102,602	13,448	12,547	953,572	93	6.95	.86
1932	144	73	217	23,766	9,853	33,619	190,082	78,823	268,905	5,172	4,247	322,772	82	9.60	1.20
1933	116	59	175	22,988	7,436	30,424	183,332	57,207	240,539	3,930	3,497	265,772	89	8.74	1.10
1934	166	86	252	37,144	16,076	53,220	297,144	128,628	425,772	7,808	7,271	552,596	93	10.38	1.30
1935	128	78	206	37,127	19,226	56,353	298,294	154,936	453,230	9,271	8,420	639,920	91	11.36	1.41

OTHER STATES

1928	263	67	330	83,959	20,458	104,417	692,477	163,564	856,041	10,893	7,680	583,680	71	5.59	0.68
1929	329	88	417	101,507	29,151	130,658	833,006	235,461	1,068,467	13,543	10,900	828,400	80	6.34	.78
1930	330	81	411	102,875	24,990	127,865	988,270	199,920	1,188,190	10,102	8,940	679,440	88	5.31	.57
1931	356	85	441	107,789	25,746	133,535	899,372	208,121	1,107,493	11,499	10,225	777,100	89	5.82	.70
1932	187	64	251	52,044	16,908	68,952	416,416	135,264	551,680	7,450	6,333	481,308	85	6.98	.87
1933	170	54	224	47,418	14,632	62,050	379,350	115,462	494,812	5,739	4,737	360,012	83	5.80	.73
1934	177	73	250	50,244	20,533	70,777	353,704	149,877	503,581	7,637	6,233	473,708	82	6.69	.94
1935	237	108	345	59,783	24,844	84,627	426,966	199,778	626,744	8,247	7,001	532,076	85	6.29	.85

FOREIGN TRADE [5]

Imports of mercury in 1936 were more than double those reported for 1935, and for the first time since 1928 imports from Italy assumed importance. The total for Italy for 1936 was the largest recorded since 1927, the last full year of operation prior to the formation of the international cartel. From the time the cartel was formed until the beginning of civil war in Spain, broadly speaking, Italy supplied the European demand and Spain the principal part of the demands of the remainder of the world. In 1936, however, the United States received 36 percent of all imported mercury from Italy.

Mercury imported into the United States, 1932–36, by countries

Country	1932		1933		1934		1935		1936	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Belgium	7,606	$3,100								
Canada			30	$7						
Italy	261,972	98,907	244,076	109,729	49,285	$33,339	68,705	$30,735	491,714	$385,236
Mexico	221	199	156,056	74,464	188,494	120,914	4,182	2,975	26,393	21,708
Spain	346,090	128,637	1,292,553	584,769	536,025	326,635	521,017	347,806	774,785	544,072
Sweden					760	600				
United Kingdom	760	571	21,449	9,038					81,760	66,801
	616,649	231,414	1,714,164	778,007	774,564	481,488	593,904	381,516	1,374,652	1,017,817

Mercury compounds imported for consumption in the United States, 1935–36

Compound	1935		1936	
	Pounds	Value	Pounds	Value
Chloride (mercuric) (corrosive sublimate)	10	$11		
Chloride (mercurous) (calomel)	998	1,187	787	$977
Mercury preparations (not specifically provided for)	79	190	547	893
Vermilion reds (containing quicksilver)	51,697	49,230	71,860	60,996
		50,618		62,866

Exports of mercury in 1936 amounted to 263 flasks, which were sent to more than two dozen countries. These statistics are the first available on exports since 1932, when 214 flasks were shipped from the country.

WORLD PRODUCTION

The following table shows the world production of mercury by countries, from 1932 to 1936:

[5] Figures on imports compiled by M. B. Price of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

World production of mercury, 1932–36, by countries

[Compiled by R. B. Miller]

[1 metric ton=29.008 flasks of 76 pounds]

Country	1932		1933		1934		1935		1936	
	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons
Algeria	1,184	40.8							116	4.0
Australia: Queensland	26	.9			3	0.1	17	0.6	78	2.7
Austria	23	.8	5	0.2			12	.4	(1)	(1)
Bolivia [2]	505	17.4			555	19.1	422	14.5	224	7.7
Chile	8	.3							(1)	(1)
China [2]	580	20.0	435	15.0	[3] 450	[5] 15.0	1,314	45.3	(1)	(1)
Chosen	26	.9					2	.1	4	.1
Czechoslovakia	1,305	45.0	194	6.7	763	26.3	2,004	69.1	(1)	(1)
Germany							116	4.0	(1)	(1)
Italy	29,480	1,016.3	17,605	606.9	12,804	441.4	28,196	[4] 972.0	(1)	(1)
Japan	69	2.4	234	8.1	196	6.8	148	5.1	(1)	(1)
Mexico	7,330	252.7	4,478	154.4	4,580	157.9	6,277	216.4	5,307	183.0
New Zealand	20	.7	99	3.4	49	1.7	7	.2	(1)	(1)
Rumania	2	.1	8	.3	2	.1	1	.1	(1)	(1)
Spain	23,656	815.5	19,626	676.6	31,799	1,096.2	35,559	1,225.8	(1)	(1)
Tunisia									25	.8
Turkey			23	.8	41	1.4	32	1.1	836	28.8
U. S. S. R. (Russia)	(1)	(1)	6,700	[4] 231.3	7,750	[4] 267.6	(1)	(1)	(1)	(1)
United States	12,622	435.1	9,669	333.3	15,445	532.4	17,518	603.9	16,569	571.2
Yugoslavia	8	.3								
	76,844	2,649.2	59,076	2,037.0	74,437	2,566.0	91,625	3,158.7	(1)	(1)

[1] Data not available. [2] Exports.
[3] Estimated. [4] Figure taken from the Imperial Institute, London.

Germany.—The successful opening up of large reserves of low-grade quicksilver ore at an old mine, the Obermoschel in the Rheinische Palatinate near Bingen, should enable Germany to supply 10 to 15 percent of her requirements in 1937, according to Wright.[6] He also reported that Germany's imports of mercury were 357 metric tons in 1932, 488 in 1933, 650 in 1934, 869 in 1935, and 455 in the first 6 months of 1936, indicating a substantial increase in consumption of this metal during the period.

Italy.—For many years Italy and Spain have been the principal mercury-producing countries of the world, with Italy leading in some years and Spain in others. The principal mercury resources of the world occur in Spain, but for the 15 years ended in 1934 Italy produced 43 percent and Spain 36 percent of the world total. Production of mercury in Italy in 1935, 28,196 flasks, considerably more than doubled that in 1934 but amounted to only about one-half of the annual average of 56,200 flasks for 1925–29. Statistics showing the quantity of metal produced in 1936 are not yet available, but with the termination of war between Italy and Ethiopia and the added demands of the world for Italian mercury because of the difficulties in obtaining Spanish supplies, it is reasonable to expect a large increase in Italian production.

Exchange difficulties restricted the movement of Italian metal to the United Kingdom and aggravated the unsatisfactory supply situation in that country. The Metal Bulletin (London) reported that Italians were willing to sell but that the British Government insisted that all payments for Italian goods should go through the official exchange clearing, whereas Italian producers, realizing the adverse

[6] Wright, Chas. Will, Germany's Capacity to Produce and to Consume Metals, Fuels, and Minerals: Special Suppl. 4, Mineral Trade Notes, Bureau of Mines, Nov. 20, 1936, p. 12.

balance to Italy of the payments in the clearing were willing to deal only on the basis of direct payment.

At the end of 1936 the Mercury Cartel, Consorzio Mercurio Europeo, which marketed metal through Roura & Forgas, was terminated. It is reported that Italian sales will be made in the future through Amalgamated Merchants, Ltd.

Mercury produced in Italy, 1933–34, by Provinces

Province	Ore mined						Metal produced				
	Number of mines	Number of workmen	Metric tons	Tenor (percent)	Value [1]	Tons per man	Number of plants	Number of workmen	Flasks (76 pounds)	Value [1]	Flasks per man
1933											
Cagliari (Iglesias) [2]							(2)	(2)	45	$3,573	(2)
Gorizia (Trieste)	1	594	45,007	0.726	$190,785	76	1	92	8,734	360,043	95
Grosseto (Firenze)	3	97	9,539	.96	78,018	98	3	43	2,882	135,220	67
Siena (Firenze)	1	179	14,000	1.05	130,469	78	2	48	5,944	278,856	124
	5	870	68,546	.826	399,272	79	6	183	17,605	777,692	[3] 96
1934											
Cagliari (Iglesias) [2]							(2)	(2)	49	1,712	(2)
Gorizia (Trieste)	1	602	44,565	.809	223,143	74	1	81	6,863	290,481	85
Grosseto (Firenze)	3	113	10,799	.38	14,961	96	4	53	1,350	64,697	25
Siena (Firenze)	2	303	16,355	.90	133.565	54	3	40	4,542	215,228	114
	6	1,018	71,719	.765	371,669	70	8	174	12,804	572,118	[3] 71

[1] Lire converted to dollars at the average annual rate of exchange, as published by the U. S. Federal Reserve Board.

[2] Product recovered in the plant of the Società di Monteponi from condensation of mercury vapor obtained in lead smelting.

[3] Exclusive of output at Cagliari.

Japan.—Only a small part of Japan's mercury requirements is produced at home, as is the case in most large mercury-consuming countries of the world. According to Trade Commissioner Steintorf, Tokyo, October 20, 1936, Japan imported 10,700 flasks in 1933 and 14,500 flasks in 1934. Although figures for 1935 were not available at that time imports for that year were thought to have been 80 percent above those for 1934, and imports for 1936 were expected to amount to as much as 29,000 flasks. Production amounted to 234 flasks in 1933, 196 in 1934, and 148 in 1935.

The richest mercury mine in Japan is said to be in Yamato Province, although its output is less than 50 tons annually. Steintorf reported that several projects were proposed to increase the output of the country, without very successful results thus far.

Mexico.—The Huitzuco mines in north-central Guerrero were discussed in a paper presented by C. W. Vaupell at the seventeenth annual meeting of Economic Geologists, in New York, February 16–17, 1937. Vaupell stated that production of the mines had been about 90,000 flasks since 1873. Near-surface ores fill extinct mud geysers, and the deep deposits are chambered veins, stockworks in brecciated blocks, and replacements in limestone. The epigenetic minerals—livingstonite, stibnite, and sulphur—occur in limestone, gypsum, and dolomite through a developed vertical range of 260 meters. The deepest workings expose an increased amount of stibnite, which probably indicates that the lower limit of mercury mineralization is being

approached. A resurgence of heat and water formed geysers over an extended area after the period of mercury mineralization. Mud geysers, which are situated in the outcrops, contain secondary mercury minerals, cinnabar, and barcenite in the gravel and mud filling the vents.

A 150-ton flotation plant is in operation concentrating stope fills that assay 3 kilograms of mercury per ton; 150,000 tons are available in one open stope, which is more than 1 hectare in area and 60 meters high.

Spain.—Official data covering operations at the Almaden mine in 1936 are not available. The civil war, with consequent labor and other difficulties, including reported attempts of the rebel forces to gain control of the mercury properties, undoubtedly caused a drop in output. According to rumors the mines were shut down at times during the year. Considerable quantities of mercury shipped from the Almaden mine are reported to have been seized by the rebels, who are supposed to have used part of the metal in payment for arms and munitions.

Output of mercury in 1935 amounted to 35,559 flasks, well above the 1930–34 average, but only 61 percent of the annual average for the 5-year period 1925–29. Exports of 66,340 flasks were considerably above production in 1935, as probably they were in 1936, the difference being drawn from stocks.

According to Consul John D. Johnson, Madrid, May 4, 1936, exports of mercury from Spain from 1931 to 1935 were as follows:

Mercury exported from Spain, 1931–35, by countries of destination

(Flasks of 76 pounds)

	1931	1932	1933	1934	1935
Belgium	985	830	1,590	4,570	15,420
Germany	1,700	2,870	4,530	2,560	7,260
United Kingdom	6,630	9,090	11,730	11,670	19,370
United States	600	4,700	16,820	6,080	10,110
Other countries	3,675	6,640	7,230	8,730	14,180
	13,590	24,130	41,900	33,610	66,340

Johnson's report stated that the largely increased exports in 1935 were attributed by interested sources in Spain to the desire of importing countries to increase their stocks of metal, because of unsettled world conditions and consequent uncertainty as to the possibility of future purchases and deliveries.

Turkey.—Demand for mercury in 1936 was brisk, and principally from Japan, Great Britain, and Germany, according to Commercial Attaché Julian E. Gillespie, Istanbul. There was increased activity at the mines on the Karaburnu Peninsula, at the entrance to the Gulf of Smyrna, in an unsuccessful effort to fill the large orders received. It was reported that an order from Great Britain for 2,500 flasks had been refused. In the third quarter of the year the mine was operating at capacity in an attempt to fill an order for 500 flasks, supposedly from Germany and at a reported price of £15.

U. S. S. R. (Russia).—If reports are correct, a large increase in output of mercury in Russia is indicated. From a recent high of 3,771 flasks in 1929, output increased to 6,700 in 1933 and 7,750 in 1934.

TIN

By R. B. Miller

SUMMARY OUTLINE

The year 1936 was noteworthy for the tin industry. The international restriction scheme was renewed, production and consumption increased, and financial statements were in general correspondingly better. However, the year was not without its adverse phases. Stocks remained low throughout the year; and the average price was lower than in 1935, although this situation righted itself in the last quarter. Demand for tin did not increase notably anywhere except in the United States where the increase was due to demands of the tin-plate and automobile industries. Generally unrewarded search for new tin deposits continued in several regions throughout the world. Progress was made, however, in the development of substitutes for tin (synthetic resins, aluminum, etc.). Owing to the export demand for tin-plate clippings (scrap) and the rise in price, the United States placed an export license on this commodity.

Salient statistics for tin in the United States, 1925–29 (average) and 1932–36

	1925–29 (average)	1932	1933	1934	1935	1936
Production—						
From domestic mines .... long tons	24	0.4	2.7	8.2	44.5	[1] 102.6
From secondary sources .... do	30,598	13,170	19,732	22,232	24,911	25,018
Imports for consumption (metal) .... do	78,009	34,819	63,718	39,986	64,258	76,030
Exports (domestic and foreign)[2]	1,740	1,117	1,041	1,216	2,292	386
Monthly price of Straits tin at New York:						
Highest .... cents per pound	70.67	24.76	53.07	55.60	52.29	51.85
Lowest .... do	39.79	19.24	22.70	50.87	46.91	42.22
Average .... do	56.64	22.01	39.12	52.16	50.39	46.42

[1] Subject to revision.
[2] Figures for 1932–36 cover foreign only; domestic not separately recorded.

Figure 40 illustrates the salient features of the tin industry since 1900. The most important feature of the chart is the parallelism between the price curve and the United States tin-imports curve; the price curve shows a definite tendency to rise and fall as the world's visible stocks decrease and increase. Stocks in the United States, although small and, from a world standpoint, virtually insignificant, nevertheless parallel the course of world visible stocks in a general

way. It is evident that consumption or demand in the United States largely determines the state of the tin-mining industry. It will be noted that mine production shows an upward tendency, but this is less intense than that for many other metals.

Third international production-control agreement.—The dominant question before the tin industry in 1936 was the renewal of the international cartel or restriction agreement. The Tin Committee, at its meeting in London on May 26, 1936, announced that Bolivia, Malaya, Netherland India, and Nigeria were willing to continue control on an agreed basis, if outside countries would satisfactorily limit their production. Siam demanded an increase in its quota to 18,000 to 20,000 long tons a year. The committee demurred, and its delegates, V. A. Lowinger and J. van den Broek, were sent to Siam to negotiate with the Siamese Government for the renewal by the People's Assembly of the restriction scheme. Eventually the Siamese Government signified its willingness to agree to the pact; it was agreed that the quota should be 18,000 tons, and the Tin Committee announced its decision on November 5, 1936. Even then the terms were not accepted by the Siamese People's Assembly until December

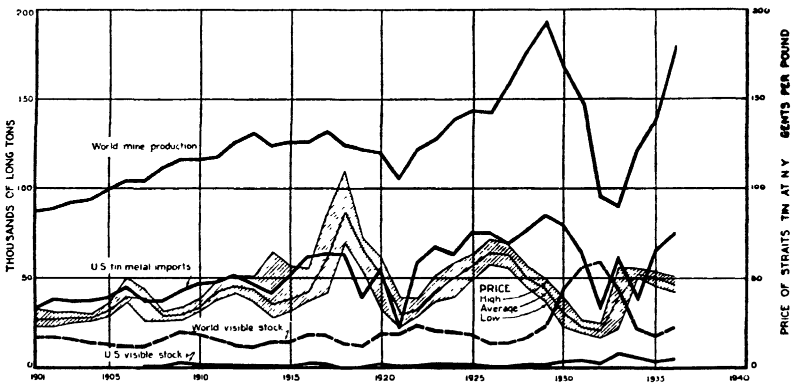


FIGURE 40.—Trends in production, imports, stocks, and prices of tin, 1901–36.

28, 1936, and the industry entered the new year uninformed as to the nature of the agreement until it was signed at Brussels on January 5, 1937; the details were made known at a still later date.

Several important differences should be noted between the old and the new agreements. The most important difference is that in the old agreement the unanimous vote of the delegates was necessary to fix the quota; in the new agreement the unanimous vote is to be replaced by a majority vote of the representatives. The number of votes available for a country is based on the relative importance of its tin-production industry: Malaya thus receives five votes, Bolivia four, Netherland India four, Siam two, Belgian Congo two, Nigeria two, and Indochina one. A total of 11 votes of the 20 will carry any proposal. Under the new agreement the committee will have plenipotentiary powers to fix quotas instead of merely recommending suggestions for the approval of the governments concerned. The two leading nations that consume tin will be represented on the council, but they will have no right to vote. The representative of the United States is John Hughes, past president of the United States Steel Products Co., and the representative of the United Kingdom is Sir William Firth.

If the production of all countries not included in the agreement exceeds either 15 percent of the world's estimated production or 12,500 long tons of tin for 6 consecutive months, any signatory country may give 6 months' notice of its intention to withdraw from the agreement. If any country becomes involved in hostilities it may apply to the committee to be allowed to export temporarily more than its permissible output. If permission, which must be accorded by unanimous vote, is refused, such country may withdraw from the scheme. Another clause provides that production and export shall be controlled during the year to correspond with the quota. This excludes the possibility of building up any unexported stock, such as a buffer pool. In the event of serious underexports signatory countries may carry forward to the next year only 8⅓ percent of their permissible exports during that year. Excess exports, on the other hand, are carried forward in full and subtracted from the succeeding year's quota. Any renewal of the agreement must be recommended not more than 12 nor less than 9 months prior to December 31, 1941. The signatories again give as their object the regulation of production and exports from producing territories, the adjustment of output to consumption, the prevention of severe fluctuations in price, and the maintenance of reasonable stocks.

Standard tonnages under the third agreement remain the same for Bolivia, Malaya, Netherland India, Nigeria, Cornwall, and Portugal. Siam's tonnage is computed on the basis of the true assay value $\left(\frac{a}{72}\times 18{,}500\right)$. The difference between the figure thus obtained and 18,000 long tons is met by a reduction of the standard tonnages of Bolivia and Belgian Congo in the ratio of 2.8 to 1. The minimum export for Siam is calculated by the formula $\left(\frac{a}{72}\times 11{,}100\right)$. The difference between the figure thus obtained and the agreed minimum export of 10,500 tons is also met by a reduction of the standard tonnages of Bolivia and Belgian Congo in the ratio of 2.8 to 1. Indochina shall not be required to produce at a rate less than 1,800 tons a year on a true assay basis.[1]

Tin-production quotas for countries signatory to the tin-output curtailment plan, 1935–37, in long tons [1]

Country	Quota basis (1934–36)	Quota (annual rate)						Quota basis (1937–41)	Quota (annual rate), 1937	
		1935		1936						
		July 1	Oct. 1	Jan. 1	Apr. 1	July 1	Oct. 1		Jan. 1	Apr. 1
British Malaya	71,940	50,358	57,552	64,746	61,149	64,746	75,537	71,940	71,940	79,134
Bolivia	46,490	32,543	37,192	41,841	39,517	34,868	41,841	46,490	46,490	51,139
Netherland India	36,330	25,431	29,064	32,697	30,881	32,697	38,147	36,330	36,330	39,963
Nigeria	10,890	7,623	8,712	9,801	9,257	9,801	11,435	10,890	10,890	11,979
Siam	9,800	10,290	11,270	12,250	11,760	12,250	13,720	18,000	18,000	19,800
Belgian Congo		7,125	7,375	7,624	7,500	7,624	8,000	13,200	13,200	14,520
Indochina		2,500	2,500	3,000	3,000	3,000	3,000	3,000	3,000	3,300
United Kingdom	14,872	1,850	2,100	2,350	2,225	2,350	2,745	(2)	(2)	(2)
Portugal		650	650	720	680	720	840	(2)	(2)	(2)
Other countries		(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)

1 For record of plan from its beginning in 1931 through 1935, see Minerals Yearbook, 1935, p. 516, and Minerals Yearbook, 1936, p. 472.
2 Data not available.
3 No restriction of output.

1 International Tin Research and Development Council, Stat. Bull., vol. 5, no. 2, 1937, p. 3.

Tin-plate-scrap export restriction.—Tin-plate scrap is one of the most important raw materials used in the production of secondary tin. To safeguard the domestic detinning industry, which was threatened with the loss of its source of supply by the recent increase in exports of tin-plate scrap, Congress passed the Faddis bill (S. Res. 3381) prohibiting the export of this commodity except under license. The bill was signed by the President on February 15, 1936.

In a press notice the Department of State reports requests for allotments totaling 91,584 long tons of tin-plate scrap for export from July 1 to December 31, 1936.[2] Allotments totaling 9,524 tons were granted in conformity with the provisions of the statement of the procedure, announced June 15, 1936. Applications for license to export, between July 1 and December 31, 1936, a total of 23,383 long tons of tin-plate scrap were received and acted upon by the Department. Forty-nine licenses were issued, authorizing the exportation during that period of 6,483 long tons of tin-plate scrap valued at $106,854. These licenses were for export to Japan only. Allotments that total 18,609 long tons of tin-plate scrap have been assigned to 39 producers for export, subject to license, during the calendar year 1937, in accordance with the provisions of the statement of procedure announced by the Acting Secretary of State on December 7. Applications for allotments totaling 27,752 long tons were received, some of which necessarily were reduced to comply with the requirements set forth in the announcement of December 7, 1936.

Tin-plate scrap exports from the United States in 1936 totaled 14,375 long tons valued at $282,214. In 1935 exports of tin-plate scrap were 34,928 long tons valued at $749,604. Waste-waste-tin-plate exports in 1936 were 80,805 long tons valued at $2,635,662. In 1935 exports of tin-plate scrap to Japan totaled 31,961 long tons, and waste-waste-tin-plate exports totaled 20,869 long tons.

DOMESTIC PRODUCTION AND RESOURCES

Primary tin.—The domestic mine output of tin from Alaska in 1936 was 102.6 long tons valued at $106,700, calculated on the average price for straight cassiterite. The continental United States produced 60 pounds of cassiterite, all from South Dakota. It is said that the dry summer adversely affected proposed placer mining in that State. Since the beginning of careful statistical compilation in 1902 the tin production of the United States has amounted to 1,365 long tons, of which only 289 long tons have come from continental United States; the remainder (1,076 long tons) was derived from Alaska. It has required 35 years to produce this quantity of tin, whereas the minimum annual consumption of virgin tin in recent years was 35,478 long tons in 1932.

Mine production of recoverable tin in the United States (including Alaska), 1925–29 (average) and 1932–36

Year	Long tons	Value	Year	Long tons	Value
1925–29 (average)	24.0	$28,800	1934	8.2	$9,600
1932	.4	220	1935	44.5	50,200
1933	2.7	2,400	1936	[1] 102.6	[1] 106,700

[1] Subject to revision.

[2] U. S. Department of State, Press Release: Vol. 16, no. 380, Jan. 9, 1937, pp. 19–20.

A recent description of the Alaska tin deposits, by Philip S. Smith, has been published by the United States Geological Survey.[3]

Secondary tin.—Production of secondary tin in the United States amounted to 25,000 long tons, which was equivalent to 33 percent of the imports of virgin tin imported as metal. The amount of secondary tin recovered showed a slight increase of 100 long tons, or 0.4 percent over the recovery in 1935.

Secondary tin recovered in the United States, 1925–29 (average) and 1932–36 [1]

Year	Tin recovered at detinning plants			Tin recovered from all sources			
	As metal (long tons)	In chemicals (long tons)	Total (long tons)	As metal (long tons)	In alloys and chemicals (long tons)	Total: Long tons	Total: Value
1925–29 (average)	900	2,000	2,900	7,500	23,100	30,600	$38,034,120
1932	600	1,600	2,200	4,200	9,000	13,200	6,248,100
1933	800	1,800	2,600	6,500	13,200	19,700	16,508,700
1934	900	1,800	2,700	7,300	14,900	22,200	25,487,600
1935	1,100	2,200	3,300	8,600	16,300	24,900	27,498,200
1936	2,300	1,500	3,800	6,500	18,500	25,000	25,621,500

[1] Figures compiled by J. P. Dunlop, of the Bureau of Mines.

IMPORTS AND EXPORTS [4]

Metal and ore.—Tin concentrates continued to occupy a negligible position in the tin trade, imports amounting to only 179 long tons in 1936. Tin concentrates from the Seward Peninsula, Alaska, were exported to Singapore, Straits Settlements, and Liverpool, England. Such shipments in 1936 totaled 344,774 pounds of concentrates, which averaged 66.6 percent tin (229,734 pounds of metal). In 1935 shipments were 173,774 pounds, which averaged 65.7 percent tin (114,182 pounds of metal).

Foreign trade of the United States in tin and tin concentrates, 1925–29 (average) and 1932–36

Year	Imports: Tin (metal)		Imports: Tin concentrates (tin content)		Exports of tin (metal) (long tons)	
	Long tons	Value	Long tons	Value	Domestic [1]	Foreign [2]
1925–29 (average)	78,009	$95,920,333	175	$100,162	637	1,103
1932	34,819	16,473,998	17	4,364	(3)	1,117
1933	63,718	51,240,829	24	10,630	(3)	1,041
1934	39,986	44,800,650	2	859	(3)	1,216
1935	64,258	69,815,287	178	106,078	(3)	2,292
1936	76,030	75,450,941	179	94,738	(3)	386

[1] Imported as ore and exported as pigs, bars, etc.
[2] Imported as pigs, bars, etc., and exported as such.
[3] Not separately recorded.

[3] Smith, Philip S., Mineral Industry in Alaska in 1935: U. S. Geol. Survey Bull. 880-A, 1937, pp. 75–77.
[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from the records of the Bureau of Foreign and Domestic Commerce.

Importation of 76,030 long tons of tin (bars, pigs, blocks, grain, granulated, or scrap, and alloys, chief value tin, n. s. p. f.) in 1936 represent an 18 percent increase over 1935. British Malaya supplied 71.5 percent of the total in 1936, an increase of 46.1 percent over 1935 imports from the Straits and the United Kingdom furnished 11.1 percent, a decrease of 45.8 percent from 1935 imports from the United Kingdom.

During 1936 exports (in reality reexports) of metallic tin amounted to 386 long tons, a marked decrease from the 2,292 tons exported in 1935 and a very small quantity compared with imports of tin.

Tin manufactures.—Imports of tin plates, terneplates, and taggers tin were 233 long tons valued at $62,048 in 1936 compared with 187 long tons valued at $48,867 in 1935. The United Kingdom furnished 218 tons or 94 percent of the 1936 imports.

Tin [1] imported for consumption in the United States, 1935–36, by countries

Country	1935		1936	
	Long tons	Value	Long tons	Value
Argentina			101	$103,947
Australia	121	$129,197	25	25,592
Belgian Congo	350	384,558	479	488,348
Belgium	100	114,360	535	547,074
Bolivia			50	50,275
British Malaya	37,209	41,082,531	54,372	53,658,930
Canada	56	38,149	62	59,086
China	2,422	2,584,612	1,029	997,879
Cuba			(2)	326
Germany	890	510,186	160	140,756
Honduras	(2)	175		
Hong Kong	3,037	3,182,696	3,554	3,386,580
Japan	10	11,288		
Mexico	18	13,130	(2)	80
Netherland India	2,492	2,713,222	2,738	2,669,369
Netherlands	1,973	1,939,417	4,485	4,613,776
Panama	1	864		
United Kingdom	15,579	17,110,902	8,440	8,708,923
	64,258	69,815,287	76,030	75,450,941

[1] Bars, pigs, blocks, grain, granulated, or scrap, and alloys, chief value tin, n. s. p. f.
[2] Less than 1 ton.

Tin plate, terneplate, and taggers tin exports in 1935 were 238,880 long tons valued at $23,752,978, an increase of 77.6 percent in quantity and 82.4 percent in value over 1935.

Tin plate, terneplate (including long ternes), and taggers tin exported from the United States, 1935–36, by principal countries and customs districts

	1935		1936	
	Long tons	Value	Long tons	Value
Country				
Argentina	10,590	$1,081,003	13,580	$1,383,889
Belgium	160	12,791	5,379	522,288
Brazil	10,683	1,019,756	18,658	1,857,646
British Malaya	1,435	137,800	6,823	645,514
British South Africa [1]			6,944	681,227
Canada	3,872	355,728	14,015	1,493,680
Chile	4,599	447,534	5,609	557,694
China	8,758	888,107	18,945	1,936,271
Colombia	2,514	262,531	3,275	338,276
Cuba	6,983	705,680	9,104	929,058
Greece	472	42,475	2,262	209,348
Hong Kong	4,913	464,688	6,912	682,961
Japan	21,549	1,874,099	18,199	1,700,467
Kwantung	1,897	185,408	3,085	301,503
Mexico	7,853	827,189	13,754	1,458,531
Netherland India	2,260	218,724	3,481	343,944
Netherlands	2,024	202,579	12,133	1,265,382
Norway	525	48,155	5,093	473,903
Peru	3,682	342,058	4,777	432,995
Philippine Islands	7,356	698,108	10,009	966,898
Portugal	828	75,100	8,164	756,344
Spain	2,388	222,020	3,312	323,856
Sweden	2,573	231,662	6,551	612,711
Syria	989	88,465	3,003	284,149
Turkey in Asia and Europe	449	42,315	7,189	680,082
U. S. S. R. (Russia)	8,455	913,499	8,454	862,876
Uruguay	6,663	664,746	11,707	1,195,966
Other countries	10,029	969,559	8,463	855,519
	134,499	13,021,779	238,880	23,752,978
Customs district				
Buffalo	2,155	203,150	5,340	571,682
Dakota	15	1,579	5,302	598,724
Maryland	64,474	5,995,818	92,699	9,077,227
New York	60,234	6,080,463	117,349	11,696,799
Philadelphia	4,273	413,006	11,969	1,185,269
Other districts	3,348	327,763	6,221	623,277
	134,499	13,021,779	238,880	23,752,978

[1] Rhodesia (Northern and Southern), Bechuanaland, and Nyasaland Protectorates.

CONSUMPTION AND USES

According to the International Tin Committee [5] the world consumption of tin in 1936 totaled 157,000 long tons compared with 142,044 tons in 1935, an increase of 10.5 percent. The ratio of total visible supply and carry-over (Straits and Arnhem) to tin consumption was 14.4 percent in 1936 compared with 9.7 percent in 1935.

Record increases in consumption in 1936 are noted in Japan, with 6,411 long tons; Poland, 1,322 tons; and Denmark, 690 tons. On the other hand, consumption in Germany decreased 18.8 percent, from 10,419 to 8,462 tons. The United States increased its consumption of tin from 62,292 long tons in 1935 to 75,643 in 1936, or 21.3 percent. Invisible stocks in the United States were 7,000 long tons at the beginning of the year and increased to 12,000 tons, only to decline at the end of the year to about 9,000 tons. According to the International Tin Committee distribution of consumption by uses was as follows: Tin plate, 35,770 long tons; solder, 11,880; bronze, collapsible tubes, and foil, 11,800; automobiles, 10,000; babbitt, 3,690; and other manufactures, 9,150.

[5] International Tin Research and Development Committee, Stat. Bull., vol. 5, no. 2, 1937, pp. 7–16.

The Bureau of Mines conducted a survey of the consumption of primary and secondary tin in the United States during 1935.[6] Questionnaires were sent to 947 concerns which reported consumption of 70,962 long tons of tin, including 55,779 tons of primary or virgin tin and 15,183 tons of secondary tin. Stocks on hand January 1, 1935, were 16,579 long tons and net purchases 71,188 tons, so that 87,767 tons were available for use in 1935; stocks as of December 31, 1935, were 14,649 long tons. Deductions for intercompany transactions in scrap in terms of tin content were 1,805 tons, while losses accounted for 351 tons. The consumption (70,962 tons) of tin by uses was as follows: Tin plate, 27,290 long tons; terneplate, 1,012; solder, 16,646; babbitt, 5,144; bronze, 4,765; collapsible tubes, 3,548; chemicals (other than tin oxide), 3,205; tinning, 2,082; foil, 1,629; tin oxide, 1,249; type metal, 1,003; pipe and tubing, 953; galvanizing, 620; miscellaneous alloys, 481; white metal, 397; bar tin, 395; and miscellaneous, 543.

Apparent consumption of virgin tin in the United States, 1925–29 (average) and 1932–36, in long tons

	1925–29 (average)	1932	1933	1934	1935	1936
Supply:						
Domestic mine production	24	(1)	3	8	45	[2] 103
Imports:						
As metal	78,009	34,819	63,718	39,986	64,258	76,030
In concentrates	175	17	24	2	178	179
Visible stocks, Jan. 1	[3] 2,844	6,254	4,496	7,504	2,638	2,312
Total available	81,052	41,090	68,241	47,500	67,119	78,624
Withdrawals:						
Exports:						
As metal	1,740	[4] 1,117	[4] 1,041	[4] 1,216	[4] 2,292	[4] 386
In concentrates	24	(1)	3	8	45	103
Visible stocks, Dec. 31	[3] 2,820	4,496	7,504	2,638	2,312	5,095
Total withdrawn	4,584	5,613	8,548	3,862	4,649	5,584
Apparent consumption	76,468	35,477	59,693	43,638	62,470	73,040

[1] Less than half a ton.
[2] Subject to revision.
[3] Figures for Jan. 1 and Dec. 31 are stocks at beginning and end of the 5-year period and not averages of stocks on Jan. 1 and Dec. 31 of each year during period.
[4] Figures for 1932–36 cover foreign exports only; domestic exports not separately recorded.

Tin plate and terneplate.—According to the American Bureau of Metal Statistics the production of tin plate in the United States in 1936 was 2,096,699 long tons compared with 1,692,380 tons in 1935.[7] This tonnage required 36,694 long tons of tin, or 1.742 percent by weight—a total of 39.02 pounds of tin per gross ton. The use of tin in pounds per gross ton has increased continuously for a number of years (from 34.45 pounds per ton in 1929). The United States is reported also to have produced 253,858 tons of terneplate, which required 1,535 tons of tin, or 0.605 percent—a total of 13.55 pounds of tin per gross ton.

The International Tin Committee reports world producton of tin plate at 3,779,000 tons compared with 3,144,000 tons in 1935.

Automobile manufacture.—According to the Bureau of the Census factory sales of vehicles of all kinds totaled 4,454,535 in 1936 compared with 3,946,934 vehicles in 1935. Exports of all classes of motor vehicles totaled 287,810. At the close of the year the outlook of the

[6] Pehrson, E. W., Umhau, J. B., and Trought, M. E., Consumption of Primary and Secondary Tin in the United States: Inf. Circ. 6930, Bureau of Mines, 1936, 12 pp.
[7] American Metal Market, vol. 44, no. 70, Apr. 14, 1937, p. 3.

automobile industry was somewhat uncertain owing to labor difficulties. In spite of the increase in the number of automobiles manufactured in recent years, there has been a steady decline in the consumption of tin per vehicle. In 1930, 8.010 pounds of tin were used per car (3,355,986 vehicles), but in 1936 only 5.108 pounds of tin were used per car (4,454,535 vehicles). This decrease is due to the substitution of other metals, notably cadmium, for tin.

Other uses.—Essential data on the can- and tinware-manufacturing industries were given in a recent Bureau of the Census report.[8] The International Tin Committee, in cooperaton with Battelle Memorial Institute, issued an informative illustrated description of tin-plate, bottle-cap, and closure manufacture and of the canning industry in the United States.[9]

The marketing of beer in cans increased during 1936. The advantages of canned beer are lower freight charges, no sorting and washing of bottles, elimination of consumer deposit, no breakage, and no deterioration of contents by exposure to sunlight. Vacuum packaging in tin containers is now being used for tobacco, coffee, typewriter ribbons, medicated tablets, and tooth powder. Apparently there is a trend for consumers to prefer tooth powder in cans, a market largely lost since the war.

PRICES AND STOCKS

Prices.—Although the highest price for tin in 1936 was near that for 1935 the low price was much lower. The average price also showed a marked decline. In May the growing deficiency in the quota assigned to Bolivia and the dissatisfaction of Siam led to apprehensions regarding the renewal of the agreement, which were reflected by the price situation in international markets. Low prices during the year were on June 26 and July 2, after which the price slowly rallied, influenced by the favorable trend in negotiations with Japan. On November 5 the renewal of the tin agreement was announced. Prices rose to the high point of the year on November 9 but declined slightly immediately thereafter. Quotations continued firm throughout the rest of the year, largely owing to general business improvement and rearmament demands in Europe.

Monthly price of Straits tin for prompt delivery in New York, 1934–36, in cents per pound [1]

Month	1934			1935			1936		
	High	Low	Average	High	Low	Average	High	Low	Average
January	53.20	50.60	51.88	51.15	50.50	50.87	48.37½	46.00	47.24
February	52.60	50.00	51.62	51.20	47.35	49.96	48.85	47.50	47.92
March	55.20	52.30	53.74	47.75	45.75	46.91	48.87½	47.20	47.99
April	56.65	54.87½	55.60	51.25	47.85	50.10	47.62½	46.50	46.94
May	54.65	52.65	53.52	52.20	50.35	51.10	47.00	44.75	46.30
June	52.50	50.25	51.22	51.80	50.50	51.07	44.50	40.50	42.22
July	52.37½	51.25	51.92	52.75	51.75	52.29	44.75	40.50	42.97
August	52.90	51.40	51.95	52.62½	48.25	50.44	43.30	42.00	42.57
September	51.95	51.15	51.49	50.25	48.25	49.07	46.00	42.87½	44.74
October	51.30	50.55	50.93	54.00	49.10	51.21	46.37½	43.95	44.94
November	51.37½	51.10	51.22	53.62½	51.00	51.88	53.50	45.85	51.31
December	51.05	50.70	50.87	52.00	48.37½	49.77	52.85	50.62½	51.85
Year	56.65	50.00	52.16	54.00	45.75	50.39	53.50	40.50	46.42

[1] Metal Statistics, 1937, pp. 357 and 359.

[8] U. S. Bureau of the Census, Tin Cans and Other Tinware: Census of Manufactures, Dec. 5, 1936, 2 pp.
[9] International Tin Research and Development Council, Tin Plate and Tin Cans in the United States: Bull. 4, London, 1936, 142 pp.

Prices of tin plate and sheet bars at Pittsburgh and pig tin at New York on dates of principal price changes for tin plate, 1930–36 [1]

Date	Tin plate (per base box)	Sheet bars (per long ton)	Pig tin (per pound)	Date	Tin plate (per base box)	Sheet bars (per long ton)	Pig tin (per pound)
			Cents				*Cents*
1930: Oct. 1	$5.00	$31.00	28.00	1933: Aug. 29	$4.65	$26.00	46.00
1931: Oct. 1	4.75	29.00	22.12½	Dec. 1	5.25	26.00	53.50
1932: Nov. 17	4.25	26.00	23.35	1936: Nov. 18	4.85	32.00	51.37½

[1] Metal Statistics, 1937, p. 145.

Stocks.—According to the Tin Committee world visible supply and carry-over amounted to 13,841 long tons at the beginning of the year and 22,695 tons at the end.[10] Stocks within the United States increased from 2,312 to 5,095 tons.

In February stocks in the United Kingdom reached such a low point that the London Metal Exchange protested to the Colonial Secretary, who returned a noncommittal reply. Nevertheless stocks reached a record low level, for on April 4, 1936, they amounted to only 369 tons. Floods in the Pittsburgh district eased the American stock position.

Visible stocks of tin in the world and in the United States at end of each month, 1925–29 (average) and 1932–36, in long tons [1]

Month	1925–29 (average)		1932		1933		1934		1935		1936	
	World[1]	U. S.	World[1]	U. S.	World[1]	U. S.	World[1]	U. S.	World[1]	U. S.	World[1]	U. S.
January	18,912	2,986	60,869	5,342	54,626	3,461	28,724	8,209	18,535	2,581	17,233	2,985
February	19,620	3,027	60,423	4,578	52,951	2,741	28,296	7,014	23,426	3,571	17,562	3,525
March	18,312	2,803	60,520	3,841	52,038	2,281	25,010	6,459	22,165	4,531	18,664	3,968
April	17,765	2,189	60,847	3,546	50,198	2,040	22,886	5,649	20,324	4,295	16,869	2,713
May	19,085	2,384	59,424	3,981	49,046	3,036	21,580	5,089	19,074	4,930	18,380	2,941
June	18,250	2,390	58,198	3,759	46,936	3,474	20,587	5,094	16,221	5,467	16,448	3,054
July	18,164	2,675	60,360	4,559	45,209	4,549	20,939	6,461	16,173	3,227	16,759	2,151
August	18,339	2,450	57,392	4,459	40,362	5,788	19,676	4,968	16,306	2,681	17,642	3,095
September	18,317	2,425	57,138	4,191	36,129	6,003	18,833	4,243	14,564	2,849	16,896	2,860
October	18,356	2,899	56,899	4,291	34,109	6,664	20,624	4,998	16,138	1,389	19,048	3,315
November	19,058	2,373	56,913	3,441	31,961	6,769	19,239	4,048	16,804	1,472	23,148	3,030
December	20,557	2,277	56,126	4,496	29,464	7,504	18,172	2,638	15,318	2,312	23,787	5,095
Average	18,744	2,573	58,759	4,207	43,586	4,526	22,046	5,406	17,920	3,275	18,536	3,228

[1] Metal Statistics, 1937, pp. 349 and 351. Beginning January 1930, figures for world stocks include carry-over in the Straits Settlements (on lighters and warrants); beginning July 1933, they also include carry-over at Arnhem (Netherlands) smelter.

WORLD PRODUCTION AND RESOURCES

World production of tin-in-ore in 1936 amounted to 180,000 long tons, an increase of 32.4 percent over the 136,000 tons produced in 1935. It is to be noted that both the total and certain production figures (notably for Australia, Belgian Congo, China, Indochina, Japan, Mexico, Netherland India, and Portugal) differ from those published by the International Tin Committee in its monthly Statistical Bulletin. The Bureau of Mines figures are compiled on the basis of the various official national statistical reports, official consular inquiries, and sundry trade information. The figures used in the following discussion for production in 1936 are those of the Tin Com-

[10] International Tin Research & Development Council: Stat. Bull., vol. 5, no. 2, February 1937, p. 16.

mittee. This committee reports the total world production of tin in 1936 as 171,888 long tons compared with the rounded figure of 180,000 long tons of the Bureau of Mines.[11] If the figures of the Tin Committee, published for comparative and regulatory purposes, are accepted it will be noted that production of the signatory countries was 153,556 tons or 89 percent of the total world production.

A comparison of the quota of 172,920 tons for 1936 and the actual production of signatory countries of 153,556 tons reveals a deficiency of 19,364 tons, 10,288 tons of which Bolivia surrendered at the end of May 1936. Production quotas were then raised for the other countries, but, even so, 1936 closed with a world gross deficiency of 9,322 tons, and a world cumulative deficiency total of 3,333 tons was carried forward. Although the Bolivian underproduction was reassigned, the deficit incurred by Bolivia in the months following May, combined with deficiencies in production of Indochina, Netherland India, and Nigeria, were insufficient to balance the small excess (698 tons) tonnage of Belgian Congo, Malaya, and Siam.

World production of tin (content of ore), 1925–29 (average) and 1932–36, by countries, in long tons

Country	1925–29 (average)	1932	1933	1934	1935	1936
Australia	2,830	2,138	2,810	2,986	3,130	3,200
Belgian Congo	967	(1)	1,576	4,356	6,118	7,514
Bolivia [2]	37,169	20,589	14,721	22,835	25,003	24,074
China [2]	7,085	2,009	9,485	6,340	9,035	11,260
India, British	2,228	3,168	3,153	4,061	4,102	[3] 4,300
Indochina	691	1,010	1,038	1,132	1,309	1,409
Japan	(1)	1,557	1,538	1,821	2,000	[3] 2,100
Malay States:						
Federated [2]	54,606	28,363	23,922	36,385	40,780	64,719
Unfederated	2,206	1,341	923	1,348	1,527	2,029
Mexico	(1)	740	(1)	(1)	621	(1)
Netherland India	33,266	16,789	12,609	19,358	20,140	31,546
Nigeria	8,319	4,320	3,755	4,996	6,568	9,529
Portugal	625	(1)	(1)	530	730	827
Siam	8,204	9,276	10,324	10,157	9,822	12,627
Union of South Africa	1,174	540	539	570	622	633
United Kingdom (England)	2,658	1,337	1,542	1,999	2,050	2,100
Other countries [4]	1,000	1,900	1,700	1,900	2,000	2,600
	163,000	95,000	90,000	121,000	136,000	180,000

[1] Less than 500 tons; included under "Other countries."
[2] Exports.
[3] Estimated.
[4] Includes countries producing less than 500 tons.

A comprehensive digest of post-war changes in world tin mining was prepared by Josef Wollnik.[12]

A more critical study of the contemporary situation in the tin industry with a brief review of its antecedents was contributed by J. K. Eastham,[13] an opponent of the restriction plan.

TIN-MINING COUNTRIES

British Malaya.—The tin-restriction agreement in Malaya has stopped development and prospecting and has caused the industry to move in a routine manner. Formerly the duty was levied on an assumed assay value of 72 percent, but under the restriction scheme

[11] International Tin Research & Development Council: Stat. Bull., vol. 5, no. 2, February 1937, p. 5.
[12] Wollnik, Josef, Zinn. Wandlungen in der Erzeugung und Verwendung des Zinns nach dem Weltkrieg: Wandlungen in der Weltwirtschaft, no. 6, Leipzig, Bibliographisches Inst., 224 pp.
[13] Eastham, J. K., Rationalization in the Tin Industry: Rev. Econ. Studies, London, vol. 4, no. 1, 1936. pp. 13–32.

this value seems inaccurate, and in 1935 the assay value averaged 75.56 percent. These high percentages suggest that the earlier totals of Malayan production were generally underestimated.

Tin is mined by almost all known methods. Production in 1936 by dredges amounted to 30,445 long tons of fine tin; gravel pumping, 24,833 tons; hydraulicking, 3,149 tons; open-cast mines, 2,558 tons; shafts in alluvial deposits, 684 tons; dulang washers, 1,028 tons; and from samples and sweepings, 60 tons.

The number of persons employed in the tin mines showed a continuous increase during the year (according to monthly figures), reaching a peak of 78,714 in December, compared with 65,328 in December 1935 and 53,037 in December 1934.

The Japanese firm, Ishihara Sangyo Koshi, Ltd., continued development work in its hematite concession at Pelepah Kanan in the State of Johore. This iron-ore deposit carries profitable values in tin, the iron ore being available as a byproduct. The tonnage is not as yet known but it is reported to be very large. Lode deposits of tin other than those of Pahang are very rare, and if this deposit proves profitable, the prospecting for tin other than alluvial may be expected to be intensified.[14] Examinations were made of possible dredgable deposits in several inland areas in the Dindings, the district between Kinta Valley and the coast.

Netherland India.—The geology of the lode and detrital deposits of Netherland India was described by Wing-Easton.[15] The Government-owned and operated Banka mines and the Billiton Tin Co. (a joint Government and private enterprise) are reported to be negotiating for an amalgamation of interests. Vereenigde Nederlandsche Tinbedrijven, the new company, will have a capital of 55 million florins, of which 4,950 shares valued at 10,000 florins each will be held by the Government and the remainder by the Billiton Co.

Bolivia.—The genesis and mineralization of the Bolivian tin belt have been reviewed by Ahlfeld.[16]

The report of the Bolivian Tin Investigation Committee, dated January 31, 1936, contains a wealth of data concerning the organization, operations, and costs of the tin-mining companies of Bolivia.[17] The committee concluded that the tin industry in Bolivia is capable of producing the quota which the international agreement assigns to it; that it is urgent to study and modify the mining laws to facilitate development of the industry through simplification of (legal) procedure; and that it is necessary to create a special organization which will serve as a contact between public authorities and producers. The committee points out further that Bolivia must promptly fulfill the quota assigned by the rationing plan and use all mechanical methods to produce the greatest amount of tin at the lowest cost. Also that the freight rates should be investigated and revised.

A. E. Donovan, Second,[18] American vice consul located at La Paz, reports that a contract was signed on December 24, 1936, between the Bolivian Government and Mauricio Bony & Co. for the establishment of tin-ore smelters in Bolivia.

---

[14] Mining Journal, London, vol. 197, no. 5306, May 1, 1937, pp. 425–426.

[15] Wing-Easton, Nicholaas, The Tin Ores of Banca, Billiton, and Singkep, Malay Archipelago: Econ. Geol., vol. 32, no. 1, pp. 1–30; no. 2, 1937, pp. 154–182.

[16] Ahlfeld, Friedrich, The Bolivian Tin Belt: Econ. Geol., vol. 31, no. 1, 1936, pp. 48–72.

[17] (*Bolivian Tin Investigation Committee*), Investigación del estaño en Bolivia. El estaño en Bolivia 1935: La Paz, Jan. 31, 1936, 179 pp. *See* U. S. Bureau of Mines, Mineral Trade Notes, vol. 4, no. 1, Jan. 20, 1937, p. 8.

[18] U. S. Bureau of Mines, Mineral Trade Notes, vol. 4, no. 3, Mar. 20, 1937, pp. 12–13.

By the Exchange Decree of March 31, 1936, the Government paid the miners approximately 37.50 bolivianos per pound sterling for ore delivered after March 31, 1936, instead of 20.00 bolivianos per pound, as during the previous months. A new decree was issued on September 5, 1936, with the provisions that the miners must deliver an additional 10 percent in drafts.

Siam.—Tin mining in Siam is particularly important in the areas of Bhuket, Nakorn Sritamarat, Rajaburi, and Pattani. H. G. Minnigerode,[19] the United States vice consul, reports that there are 21 dredging companies with 28 dredges in operation. Four additional companies are preparing to begin operations, and 10 more dredges are under construction. Prior to 1928–29 some tin ore was smelted in Siam, but smelting has now all but stopped, and the output is shipped either to Penang or Singapore for smelting.

China.—It is reported that the Kotchiu smelter in Yünnan Province, China, is being further enlarged. During 1935 the smelter produced about 2,000 tons of tin, and production during 1936 has been on a still larger scale.

In the Hunan Province cassiterite-arsenopyrite deposits occur as pipelike deposits in dolomitized limestone.[20]

Belgian Congo.—At present tin is produced in the Provinces of Costermansville and Elisabethville, Belgian Congo. The Géomines, using electrical smelting methods, produced 1,588 tons of metallic tin for the first time in 1935. The remainder of the ore produced in Belgian Congo is shipped to Hoboken, Belgium, for smelting.

Burma.—The Government of Burma has authorized a geological survey of an area of about 2,000 square miles in the Southern Shan States by the Mawchi Mines, Ltd., of London. This area is in the same zone as that now being exploited for tin and tungsten by the same company. The company has invested additional money in a plant to treat tailings from the Mawchi mill and in equipment for working alluvial deposits, which are estimated at 1,000,000 cubic yards.[21]

Australia.—The concentration of tin ores of Australia was the subject of considerable discussion during the year.[22] Descriptions were published of the Torrington tin field, the largest in New South Wales,[23] and of the alluvial mining area at Eldorado near Wangaratta, Victoria.[24] The latter area is being opened up as a result of renewed activity in gold mining with dredges. Two new companies (Anglo Tasman Development Co. and Tasmanian Amalgamated Tin Mines) were organized to work part of the Renison Bell pyritic tin deposits on the west coast of Tasmania. These ores aggregate more than 1,000,000 tons and assay about 0.6 percent metallic tin. The treatment of these ores is under investigation.[25]

---

[19] U. S. Bureau of Mines, Mineral Trade Notes, vol. 4, no. 2, Feb. 20, 1937, pp. 16–17.

[20] Wang, C. C., and Hsiung, Y. H., The Cassiterite-Arsenopyrite Pipes in Southern Hunan, China: China Geol. Surv. Bull. 26, 1935, 105 pp.

[21] U. S. Bureau of Mines, Mineral Trade Notes, vol. 3, no. 6, Dec. 19, 1936, p. 7.

[22] Chemical Engineering and Mining Review, Flotation of Cassiterite Needs Research: Vol. 28, no. 332, May 8, 1936, pp. 246–247.

Cropp, W. H., Australia's Low Grade Tin Deposits and Research on Cassiterite Flotation: Chem. Eng. and Min. Rev., vol. 26, no. 336, Sept. 8, 1936, pp. 451–452.

[23] McKeown, M. R., The Torrington Tin Field: Chem. Eng. and Min. Rev., vol. 28, no. 336, Sept. 8, 1936, pp. 425–430.

[24] O'Malley, G. B., Sluicing for Gold and Tin. The Operations of Cock's Pioneer: Chem. Eng. and Min. Rev., vol. 28, no. 333, June 8, 1936, pp. 289–294.

[25] Chemical Engineering and Mining Review, Renison Bell Tin Deposit. An Unsolved Metallurgical Problem: Vol. 28, no. 329, Feb. 8, 1936, pp. 138–139.

TIN SMELTERS

During 1936 the recent tendency to expand and enlarge existing smelter facilities received additional impetus. A new (the fourth) furnace is being constructed at the Arnhem smelter in the Netherlands and will be completed by August 1937. The Kotchiu smelter in southern China is being enlarged. In 1935 the electrical smelting of tin was begun in the Belgian Congo. Likewise tin smelting was begun in Argentina. Negotiations are in progress to construct a smelter in Bolivia. A new smelter is almost completed near Liverpool, England.

Smelter production of tin, 1925–29 (average) and 1932–36, in long tons

Country	1925–29 (average)	1932	1933	1934	1935	1936
Argentina			40	200	[1] 500	(2)
Australia	2,952	1,958	2,360	2,330	2,837	(2)
Belgian Congo					1,588	(2)
Belgium [1]	720	800	2,700	3,900	4,200	(2)
British Malaya [3]	88,855	49,945	46,942	49,637	60,479	84,591
China	[4] 7,080	7,139	8,226	7,878	9,700	(2)
France	359	187	50		(2)	(2)
Germany	3,444	1,871	1,633	2,156	[1] 2,100	(2)
Japan	606	1,961	950	1,199	2,027	1,830
Netherland India [4]	14,749	8,091	8,792	10,506	11,221	12,854
Netherlands [1]	[5] 1,000	3,500	5,000	13,411	15,600	(2)
Norway	(2)	242	160	174	454	(2)
Portugal	[6] 2	74	84	39	1	(2)
Siam	[7] 113	1	(8)	(8)	(8)	(8)
United Kingdom [1]	45,800	28,500	18,200	25,600	29,100	34,100
	165,000	104,000	95,000	117,000	140,000	(2)

[1] Estimated.
[2] Data not available.
[3] Exports plus difference between carry-over at end and beginning of year.
[4] Exports.
[5] Estimated production in 1929.
[6] Average for 1926–27.
[7] Average for 1926–28.
[8] Less than 1 ton.

ARSENIC AND BISMUTH

By HERBERT A. FRANKE [1]

SUMMARY OUTLINE

Domestic consumption of white arsenic reached a new peak in 1936. Sales by domestic producers nearly equaled the previous record of 1934, and imports were the highest ever recorded. The extension of the market for this product has been due to its effectiveness as an insecticide and weed killer. In 1936 these uses took 85 percent of the total consumed.

The world output in 1936 continued at approximately the same level established in the previous year. Production in Sweden still exceeds market demands, and the problem of storing the excess output is becoming acute.

Salient statistics for arsenic in the United States, 1925–29 (average), 1933–36

	1925–29 (average)	1933	1934	1935	1936
WHITE ARSENIC					
Domestic sales: [1]					
Crude .... short tons	2,364	3,029	9,030	6,985	8,755
Refined .... do	10,035	8,768	6,593	5,685	6,826
Imports for consumption .... do	10,769	10,583	14,110	15,075	17,585
Apparent supply [1] .... do	23,168	22,380	29,733	27,745	33,166
Average value for domestic sales: [1]					
Crude .... cents per pound	2.69	2.42	2.36	1.47	1.52
Refined .... do	3.57	2.79	2.82	2.57	2.58
OTHER ARSENICALS					
Imports for consumption:					
Metallic arsenic .... pounds	208,672	100,258	61,918	64,376	81,671
Sulphide (orpiment and realgar) .... do	575,506	674,002	628,326	710,967	355,463
Arsenic acid (H_3AsO_4) .... do	14,692	150	100	150	149
Calcium arsenate .... do	1,452	11,023	24,000	182,900	817,200
Lead arsenate .... do	[2] 2,133	1,000			
Sheep dip .... do	135,929	106,751	237,037	163,660	224,097
Paris green and london purple .... do	4,402	46,051	8,899	38,085	33,207
Sodium arsenate .... do	82,105	4,974	8,244	11,411	4,694
Exports:					
Calcium arsenate .... do	[3] 2,159,168	2,585,824	3,356,342	4,104,810	6,294,563
Lead arsenate .... do	[3] 1,328,828	598,699	650,256	1,156,922	827,560

[1] Includes sales by domestic producers for export.
[2] 10,467 pounds in 1925 and 200 pounds in 1929; no imports from 1926 to 1928, inclusive.
[3] Average for 1928–29; exports of calcium arsenate and lead arsenate not separately recorded by Bureau of Foreign and Domestic Commerce prior to 1928.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

PRODUCTION

The 1936 domestic production of 15,379 short tons of arsenious oxide (As_2O_3, white arsenic) was 8 percent more than the 14,237 tons produced in 1935. The tendency of producers to market more of their product crude was continued in 1936. Of the total sales, 56 percent was crude arsenic and 44 percent refined arsenic. In 1935, 55 percent of the total sales was crude. Much of the arsenic classified as crude, however, closely approximates a refined product, averaging better than 98 percent purity. Producers designated their output as refined white arsenic, crude white arsenic, refinery crude, flue dust (black arsenic), wood-preserver paste, and weed killer. The United States producers are Anaconda Copper Mining Co., American Smelting & Refining Co., Jardine Mining Co., and United States Smelting, Refining & Mining Co.

Average receipts from sales, as reported by domestic producers, were 1.52 cents per pound for crude arsenic and 2.58 cents for refined arsenic. Of the 15,581 short tons of white arsenic sold in 1936, 8,755 tons valued at $266,113 were sold as crude and the balance (6,826 tons valued at $352,713) as refined white arsenic.

CONSUMPTION

The total supply of white arsenic in 1936 amounted to 33,166 short tons, 20 percent more than in 1935. Of the 1936 total, 47 percent was derived from domestic production and 53 percent from imports. Exports, as reported by domestic producers, were about 1,000 short tons in 1936 and 800 tons in 1935, leaving a net consumption of 32,166 short tons in 1936 and 26,945 tons in 1935.

In addition to the white arsenic consumed in the United States, many arsenic products are imported for consumption; details are shown in the salient statistics table at the beginning of this chapter.

White arsenic is used for a variety of purposes. Each year the Bureau of Mines asks domestic producers to distribute their sales according to uses. Although the results represent only approximations, they show in general the importance of various industries as consumers of arsenic. The distribution in 1936 was as follows: Insecticides, 67 percent; weed killer, 18; wood preservative, 4; glass industry, 3; miscellaneous, 1; and exports, 7.

Since most of the white arsenic is consumed as an insecticide and weed killer, demand is heaviest in the spring and summer. No important new uses for arsenic were developed during 1936.

The principal arsenical insecticides are calcium arsenate ($Ca_3(AsO_4)_2+3H_2O$) and lead arsenate ($Pb_3(AsO_4)_2$). Large quantities of calcium arsenate are used to poison the cotton-boll weevil in the Southern States; it is also used as a germicide and fungicide. Lead arsenate is used as an insecticide either directly or as an ingredient of various preparations. Sodium arsenate ($Na_3AsO_4.12H_2O$) is used in manufacturing lead arsenate, in insecticidal and germicidal compounds, drying colors, printing inks, and medicine, and as a mordant in dyeing and printing textiles. Sodium arsenite ($NaAsO_2$) is used in manufacturing insecticides, soaps, dyeing textiles, preserving hides, and general antiseptics. Since 1934, when the Government began to help combat the grasshopper menace in the drought-stricken West and Middle West, much sodium arsenite solution has been consumed

for grasshopper bait. Sodium arsenite is used extensively as a weed killer, and in Australia it is employed to kill green timber during the clearing of land.[2]

The domestic consumption of insecticides and fungicides during 1934,[3] which holds approximately true for 1935 and 1936, included the following arsenicals: Lead arsenate, 40,000,000 pounds; calcium arsenate, 30,000,000 pounds; paris green (copper aceto-arsenite), 4,000,000 pounds; white arsenic for grasshopper bait, 7,924,000 pounds; sodium arsenite solution (32 percent As_2O_3) for grasshopper bait, 175,000 gallons. In addition, considerable quantities of the following were used: Zinc arsenite, magnesium arsenate, manganese arsenate, arsenical cattle dip; and sodium arsenite (used as a weed killer). Calcium arsenate contains approximately 40 percent As_2O_5 and lead arsenate about 30 percent As_2O_5.

The most important use of metallic arsenic is in arsenical copper, where it increases corrosion and erosion resistance, raises the annealing temperature, and perhaps serves as a deoxidizer. Arsenical copper is used to a great extent in Europe for locomotive-firebox staybolts and plates. In this country it is used in automobile radiators and other manufactured products assembled by soldering because of its higher annealing temperature. Arsenic is also used in the manufacture of lead shot, lead-antimony alloy anodes, railway brasses, muntz metal, and speculum metal for mirrors of reflecting telescopes; some is also consumed in lead-tin alloy bearing metals.

PRICES

The total value and the average price received by producers from sales of crude and refined white arsenic are stated in this chapter under Production. The following table shows the range of quotations for various arsenic compounds. No appreciable changes were recorded in 1936.

Range of quotations on arsenic and its compounds at New York (or delivered in East), 1935–36 [1]

	1935 (cents)	1936 (cents)
Arsenic metal, lump, cases .... per pound..	40.00–48.00	42.00–48.00
White arsenic (As_2O_3), domestic, kegs, carlots .... do....	3.50	3.50
White arsenic, Japanese, cases .... do....	3.50–4.50	3.75–4.50
Red arsenic, (As_2S_2), imported, cases .... do....	15.75–16.50	15.75–16.25
Calcium arsenate, wholesale, drums, carlots .... do....	6.00–6.50	6.00
Lead arsenate, wholesale, drums, carlots .... do....	9.00–9.50	9.00–9.38
Sodium arsenate, drums .... do....	9.50–11.50	9.50–11.50
Sodium arsenite (liquid), drums .... per gallon..	40.00–75.00	40.00–75.00

[1] As reported by Oil, Paint, and Drug Reporter.

FOREIGN TRADE

The amount of white arsenic imported for consumption in 1936 increased 17 percent and was the highest on record; of the total, Mexico supplied 46 percent, Sweden 36 percent, Belgium 6 percent, Japan 5 percent, and Australia 4 percent. Of outstanding interest was the large importation of arsenic from Sweden. Mexico, however, continued to be the principal foreign source of supply.

[2] Imperial Institute, Some Metallic and Inorganic Compounds Used as Weed Killers: Bull, vol. 34, no. 2, April–June 1936, pp. 195–197.

[3] Roark, R. C., Insecticides and Fungicides: Ind. and Eng. Chem., vol. 27, no. 5, May 1935, pp. 530–532.

Imports of arsenical compounds other than white arsenic in 1936 appear in the table of salient statistics. Imports of metallic arsenic increased 27 percent over those in 1935, calcium arsenate 347 percent, and sheep dip 37 percent, whereas receipts of arsenic sulphides decreased 50 percent, paris green and london purple 13 percent, and sodium arsenate 59 percent.

Official export data for white arsenic are not available, but reports of individual domestic producers indicate that about 1,000 short tons were sold for export in 1936, compared with about 800 tons in 1935; the normal total in previous years was about 2,000 tons. Exports of calcium arsenate in 1936 increased 53 percent while exports of lead arsenate decreased 28 percent.

White arsenic imported into the United States, 1932–36, by countries

Country	1932		1933		1934		1935		1936	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Australia	6	$380	452	$23,001	39	$1,494	56	$2,334	690	$30,500
Belgium	278	18,698	239	13,760	11	705	129	4,450	1,000	30,433
Canada	841	60,462	457	31,404	672	44,710	1,068	65,540	378	25,908
France	537	16,194	3,810	113,606	3,338	94,859	2,354	65,609	44	1,419
Germany	252	15,927	219	12,482	35	3,845	10	906	23	2,213
Japan	1,643	63,659	1,337	60,397	1,311	61,126	1,058	42,866	887	41,957
Mexico	3,325	182,671	4,041	256,611	8,704	500,970	9,274	525,140	8,174	426,590
Sweden			28	1,281			1,126	30,524	6,389	182,204
	6,882	357,991	10,583	512,542	14,110	707,709	15,075	737,369	17,585	741,224

WORLD PRODUCTION

World production of white arsenic in 1936 remained approximately at the 1935 level. Virtually all of the world's arsenic is produced as a byproduct in the treatment of gold, copper, lead, zinc, cobalt, silver, tungsten, and tin ores.

World production of arsenic ore and white arsenic, 1932–36, in metric tons

[Compiled by R. B. Miller]

Country and product	1932	1933	1934	1935	1936
Australia:					
New South Wales:					
Ore and concentrates [1]	(2)	2,685	4,185	4,387	----------
White arsenic	495	452	632	370	124
Western Australia: White arsenic	1,501	1,352	1,657	3,788	3,526
Belgium-Luxemburg Economic Union: White arsenic [3]	2,045	2,579	3,554	3,093	2,731
Brazil: White arsenic	211	322	322	696	732
Canada: White arsenic	1,100	666	747	1,161	619
China: White arsenic	1,427	1,159	1,206	[3] 137	[3] 99
Chosen: White arsenic	----------	153	332	373	(2)
Czechoslovakia: Ore:					
Gross weight	5	----------	----------	----------	(2)
Arsenic content	1	56	----------	----------	(2)
France:					
Ore: [4]					
Gross weight	150,125	(2)	169,150	(2)	(2)
Arsenic content	4,460	5,885	7,010	(2)	(2)
White arsenic	6,333	8,609	8,599	[3] 5,612	[3] 2,864
Germany:					
Ore:					
Gross weight	2,824	28,191	28,356	28,759	(2)
Arsenic content	196	2,037	1,961	1,315	(2)
White arsenic [3]	3,459	2,662	2,752	5,508	2,739
Greece: White arsenic	385	336	149	167	(2)
Japan: White arsenic	2,637	2,375	2,734	3,161	(2)
Mexico: White arsenic	3,991	4,697	7,860	9,950	8,527
Portugal: White arsenic	59	2	40	73	(2)
Sweden:					
Ore:					
Gross weight	198,231	373,520	233,962	278,432	(2)
Arsenic content	20,035	38,446	28,618	24,418	(2)
White arsenic	----------	861	7,405	6,350	(2)
Turkey: Ore:					
Gross weight	306	1,906	16,491	29,731	(2)
Arsenic content	122	762	6,596	9,200	(2)
Union of South Africa: White arsenic	4	----------	----------	----------	----------
United Kingdom: White arsenic and arsenic soot	251	123	188	175	156
United States: White arsenic (sales)	11,324	10,702	14,173	11,494	14,135

[1] Gross weight. Arsenic content not stated.
[2] Data not available.
[3] Exports of domestic product.
[4] Includes arsenopyrites, mispickel, and realgar.

Argentina.—Sodium arsenate has been found effective in poisoning the locusts in Argentina, which are said to destroy 30 percent of the annual agricultural crop. The Argentine Ministry of Agriculture has a small chemical plant near Buenos Aires for the production of sodium arsenate.

Australia.—White arsenic is recovered chiefly from the arsenopyrite in the gold ores of Western Australia and New South Wales. Some arsenic is obtained from the tin concentrates of the Ottery mine at Tent Hill. A. Victor Leggo, Ltd., produces most of the country's arsenic from ore of the Wiluna gold mine at Wiluna, Western Australia. In the process, roaster gases from heated flotation concentrates are drawn by a multivane fan into a condensing plant consisting of a series of concrete chambers equipped with a system of baffles. The remaining gases are treated further in a Lodge-Cottrell precipitator before passing to the main stack.

Belgium.—White arsenic produced by the Société Générale Métallurgique de Hoboken at its Reppel works is derived from speiss obtained from the furnaces at Hoboken. Much of the arsenical ore probably originates at the copper properties of Union Minière du Haut-Katanga in the Belgian Congo.

Brazil.—The white arsenic of Brazil is derived chiefly as a byproduct from the gold ores of the St. John del Rey and Ouro Preto mines.

Canada.—Refined white arsenic and arsenical insecticides are made from the cobalt-silver-arsenic ores treated by the Deloro Smelting & Refining Co., Ltd., Deloro, Ontario. A baghouse to extract arsenic from the fumes of a small roasting plant used in the treatment for the recovery of gold was put in operation in the fall of 1935 by the O'Brien Gold Mines, Ltd., Cadillac Township, Quebec. The Beattie mine, Quebec, and the Bralorne mine, British Columbia, ship arsenical gold concentrates to the United States. Some of the arsenical gold concentrates in Nova Scotia are also treated for their arsenic content.

China.—Arsenic is found chiefly in the Provinces of Hunan and Yünnan. Most of the arsenic occurs as arsenopyrite, orpiment, and realgar, and some of the mines are worked solely for arsenic. The Hunan production, however, is a byproduct from the ores of tin, lead, zinc, antimony, and tungsten.

France.—The Combe-de-Saut plant of the Société des Mines et Usines de Salsigne recovers an estimated 10,000 metric tons of arsenious oxide annually from the gold-bearing arsenopyrite and pyritic ores mined in the Department of Aude.

Germany.—The Arsenic Mining & Smelting Works "Reicher Trost" at Reichenstein each month normally treats approximately 2,200 metric tons of arsenic ore, which is derived from the arsenopyrite deposits at Reichenstein, Altenberg, and Rothenburg in Silesia. The company furnishes much of the German output of white arsenic and also controls a chemical plant (Chemische Fabrik Wilhelmsburg at Harburg-Wilhelmsburg) with a monthly production capacity of 350 tons of insecticide. The Müldenhütten plant near Freiberg treats arsenical ores from the Mansfeld copper mines and imported ores.

Japan.—Although most of the Japanese arsenic output is recovered as a byproduct in the smelting of copper and lead ores, numerous small mines are operated for their arsenic product alone.

Mexico.—The white arsenic of Mexico is a byproduct from smelters of the Cia Minera de Peñoles, S. A. (American Metal Co.), at Torreón, Coahuila, and the American Smelting & Refining Co. at San Luis Potosí. The American Metal Co. production is important in the United States arsenic market.

Sweden.—The Bolidens Gruv AB., the largest producer and holder of arsenic in the world, maintains a laboratory at Stockholm for research on new uses for arsenic. Some success has been achieved, especially in the fields of insecticides, timber preservation, and corrosion-resistant concrete. It is said that the company now holds stocks of approximately 295,000 metric tons of arsenious oxide (As_2O_3). The sulphide ores at Boliden average about 0.6 ounce gold, 2 ounces silver, 1.8 percent copper, 30 percent sulphur, and 9.1 percent arsenic. Arsenious oxide is recovered from the roaster gases at Rönnskär by cooling and precipitation. A small part of the crude arsenic is refined, and the rest is stored in a huge concrete silo. The two methods used for refining include resublimation of crude arsenic in a small reverberatory furnace fired by producer gas and a special wet process. Crude-arsenic production is reported to average 40,000 metric tons annually; the export market is able to take only about 7,000 tons.

Arsenic is being used as a preservative for telephone poles and lumber. In investigating the value of different arsenic compounds as fungicides for wood preservation, it has been found that zinc arsenate is the most efficient and economical. It is applied preferably by double impregnation, first with sodium arsenate and afterward with zinc chloride. Zinc arsenate is thus precipitated in the wood tissues.[4] Experiments by the Zoological Marine Laboratory at Kristineberg show that arsenic-impregnated wood is free from damage by shipworms. Piles and other timber under water are preserved by an arsenic concrete spray. The Royal Board of Roads and Water Constructions has found that spraying an arsenic-concrete compound on wooden poles is more expensive than impregnation. A hydraulic cement, with aluminum arsenate as the principal constituent, has been developed by Boliden. It is said that this cement is especially effective for railway ties and sewage piping.

The Boliden company recently received patents on complex ammonia arsenic salts for the protection of plants and trees against fungi and insects. These salts, containing arsenic as well as another metal and ammonia, are said to be rather insoluble and, therefore, are superior to some arsenic sprays that contain or that form acid components injurious to the green parts of plants and trees.[4]

United Kingdom.—White arsenic and arsenic soot are recovered in the treatment of tin ores from mines in Cornwall and Devon. Cornish interests, which were receiving £12 10s. to £15 10s. per long ton for their white arsenic in 1936, lowered their price to £12 per ton in March 1937.

Lunevale Products, Ltd., Lancaster, has obtained a patent on a modified process for the production of a substantially dry sodium arsenite, for which are claimed moisture-resisting properties.[5]

U. S. S. R. (Russia).—Arsenic is reported to be produced from deposits in the Southern Urals, Tadzhikistan, and near the Angara River in Siberia. A new arsenic plant is also under construction in Upper Svanetia.

BISMUTH

Domestic production of bismuth in 1936 probably increased substantially, but statistical details are not available. As imports of the metal also increased, it is reasonable to assume that consumption was much greater. Pharmaceutical compounds continue to be the principal consumers of bismuth, but the many useful alloys now available indicate that this field offers the best opportunity for expanding the use of bismuth. Prices were maintained at $1 per pound in New York throughout 1936.

Outside the United States, substantial gains in output were reported during 1936 by Canada and Peru, but Mexican output declined.

PRODUCTION

Statistics on the domestic production of bismuth are not available. Since 1935 the three major producers of bismuth in the United States have been the American Smelting & Refining Co., United States

[4] Robak, C. A., Progress in Research on Arsenic Fungicides Shown: Ind. and Eng. Chem. (News Ed.), vol. 14, no. 15, Aug. 10, 1936, pp. 298–299.
[5] Chemical Industries, February 1936, vol. 38, no. 2, p. 163.

Smelting, Refining & Mining Co., and Anaconda Copper Mining Co. The American Bismuth Mines are also reported to recover bismuth at its property 10 miles northwest of Tyrone, N. Mex.[6] Besides these domestic producers, the Cerro de Pasco Copper Corporation and the American Metal Co. are important distributors of bismuth in this country.

Some bismuth is recovered from imported lead bullion, alloys, ores, and residues coming principally from Peru, Mexico, and Canada.

CONSUMPTION

Approximately 75 percent of the world production of bismuth is used in the manufacture of pharmaceutical compounds, which require a product better than 99.99 percent pure. These are used chiefly in indigestion remedies, astringents, and toilet powders and in treating wounds. Next in importance is the use of the metal in the production of low-melting-point and nonshrinking alloys. Low-melting alloys are used in making safety plugs for boilers and compressed-gas storage cylinders, automatic sprinkler heads, firedoor releases, dental models, and low-melting solders. Fusible bismuth alloys usually include lead, tin, cadmium, mercury, or antimony. The ternary eutectic of bismuth, lead, and tin melts at 205° F., and the binary eutectic of bismuth and lead melts at 257° F. An almost endless series of alloys with melting points between warm water and the melting point of lead may be obtained by modification of the composition of the alloys.

A matrix alloy of bismuth, lead, tin, and antimony is marketed for use in mounting punch and die parts and to anchor parts accurately and permanently in machine tools, in molds for pressing cold plastics, and in a large number of other applications. This alloy melts at 248° F. and expands on cooling. A low-temperature-melting metal (160° F.) consisting of bismuth, lead, tin, and cadmium has been developed for bending tubing and metal molding and for joining the ends of quartz rods and tubes. A lead-bismuth alloy that melts at 255° F. and does not expand or contract on solidifying is used in the foundry to duplicate wood patterns, in making low-melting and fusible alloys, and as a fusible metal for safety purposes. Small amounts of bismuth are also consumed in the manufacture of special instruments, in iron castings, in aluminum alloys, in the production of X-ray-proof rubber goods, and in special brake linings.[7] Minor amounts of bismuth compounds are used in porcelain painting, enameling, and optical-glass manufacture.

PRICES

According to the Engineering and Mining Journal Metal and Mineral Markets, the New York price for bismuth metal remained unchanged at $1 per pound in ton lots throughout 1936. London quotations remained at 4s. per pound.

FOREIGN TRADE

Imports of bismuth metal during 1936 were 11 percent greater than in 1935. Additional quantities are imported in intermediate metallurgical products, statistical data for which are not available. Exports of bismuth metal are not recorded but normally are unimportant.

[6] Leach, A. A., A New Bismuth Operation: Min. Jour. (Arizona), vol. 20, no. 9, September 1936, pp. 4, 36.
[7] Smith, Walter C., Bismuth; Modern Uses of Nonferrous Metals: Am. Inst. Min. and Met. Eng. Series, 1935, pp. 54–64.

Bismuth and "compounds, mixtures, and salts of bismuth" imported for consumption in the United States, 1932-36

Year	Bismuth		Compounds, mixtures, and salts of bismuth	
	Pounds	Value	Pounds	Value
1932	28,620	$29,295	3,095	$5,283
1933	28,530	28,504	36	206
1934	19,327	19,927	305	1,814
1935	102,051	78,061	871	4,798
1936	113,443	86,722	564	4,807

WORLD PRODUCTION

Official data on the total world output of bismuth are not available. The United States, Peru, Mexico, Canada, Spain, Germany, and Japan are the principal producing countries. Most of the world's bismuth is obtained as a byproduct from lead, copper, tin, silver, and gold ores.

On the North American Continent, besides the United States, Mexico and Canada are important bismuth producers. In Mexico ore containing 166 metric tons of bismuth was reported in 1936, compared with 214 tons in 1935. Canadian production totaled 165 metric tons compared with 6 tons in 1935. The Deloro Smelting & Refining Co., Deloro, Ontario, exports silver-lead-bismuth bullion obtained from the treatment of ores from Cobalt, and the Consolidated Mining & Smelting Co., Trail, British Columbia, produces metallic bismuth from lead-zinc ores.

Peru, Bolivia, and Argentina are the principal South American producers. The Cerro de Pasco Copper Corporation in Peru furnishes much of the world's bismuth, which is derived as a byproduct of lead smelting at its Oroya smelter. The Peruvian output increased from 151 metric tons in 1935 to 386 tons in 1936. The 1935 exports totaled 112 tons of metal of 99.9 percent purity. In Bolivia, bismuth is recovered as a byproduct of tin-silver mining. Production netted 64 metric tons in 1936. The high-grade bismuth mines of the Compagnie Aramayo de Mines en Bolivie at Tasna ceased operating after 1929, when Cerro de Pasco became a large factor in the bismuth industry.

In Europe, Spain, Germany, the United Kingdom, Sweden, France, and Rumania produce bismuth. The principal producer is Spain, with mines at Azuel and near Torrescampos in the Province of Cordoba. German bismuth is obtained as a byproduct from imported ores and from domestic ores coming from the Erzgebirge in Saxony. The United Kingdom has long marketed and refined bismuth. In Sweden the sulphide ores of Boliden carry bismuth. The Société des Mines et Usines de Salsigne in southern France produces a small amount of bismuth.

In Australia, Queensland and New South Wales produce most of the bismuth, usually found associated with gold ores. The Bismuth Products, Ltd., at Mount Biggenden, Queensland, produced 40,316 pounds of bismuth from 6,759 tons of ore in 1935 compared with 26,332 pounds of bismuth in 1934.

Japan and China produce most of Asia's bismuth output. Japanese production (54 metric tons in 1935) is chiefly a byproduct of copper and lead smelting.

The Union of South Africa produced 19 metric tons of bismuth in 1936. The altered pegmatite in the Steinkopf Native Reserve of Namaqualand is the principal source of supply.[8]

[8] Mineral Resources of the Union of South Africa, Dept. of Mines, Pretoria, 1936, pp. 177-178.

MAGNESIUM

By Herbert A. Franke

SUMMARY OUTLINE

Domestic production (sales) of metallic magnesium in 1936 declined 8 percent compared with 1935, but this decline probably was due to loss of foreign markets, recently an important factor in total sales, rather than to decreased consumption in the United States. Lack of data on the volume of exports of this metal prevents an accurate appraisal of domestic consumption, but increased activity in the various industries using magnesium suggests a substantial rise in its use in 1936. Consumption of magnesium as a deoxidizer in the metallurgical industry and as a component in aluminum and other alloys probably continued at a high rate. Outstanding in 1936, however, was the increased application of high-magnesium alloys as construction materials. Castings and extruded products led this advance. The quoted nominal price of magnesium at New York remained unchanged at 30 cents per pound.

The world magnesium industry made rapid strides in 1936. Several countries began producing for the first time, and others expanded their output and improved their processes. Germany remained by far the chief producer. Increased activity abroad was due largely to armament and self-sufficiency programs, although new commercial uses and improved business conditions also were important factors. In Europe as well as the United States the use of magnesium alloys in aircraft, transportation, and portable equipment is extensive and growing rapidly.

PRODUCTION

Since 1930 data on actual production have not been available, but the quantities sold annually have been reported. These include exports and amounts used by the manufacturer in other products.

The Dow Chemical Co. of Midland, Mich., continued to be the sole producer of magnesium in the United States in 1936. Sales of new metal in 1936 decreased 8 percent from 1935. Secondary magnesium has not yet become an important factor in the industry. Byproducts derived from the fabrication of magnesium products are cleaned and reused by the manufacturers, but there is no established scrap market.

Domestic primary magnesium sold or used, 1929–36

Year	Pounds	Value	Year	Pounds	Value
1929	908,351	$512,313	1933	1,434,893	$377,181
1930	559,631	268,864	1934	4,249,838	(1)
1931	580,463	199,633	1935	4,241,218	(1)
1932	791,699	228,653	1936	3,903,312	(1)

[1] Bureau of Mines not at liberty to publish figures.

Commercial production of magnesium began in the United States in 1915. By 1917 there were five producers, but when Government war requirements for magnesium ceased the number of producers declined. Subsequently, the American Magnesium Corporation at Niagara Falls, N. Y., and the Dow Chemical Co. at Midland, Mich., were the only producers. Since May 1927 Dow Chemical Co. has furnished all of the domestic output. The American Magnesium Corporation moved its fabrication equipment to Cleveland, Ohio, in July 1928, where it continues to manufacture magnesium products.

Magnesite was used formerly as a raw material in making ingot magnesium, but now natural brine pumped from wells 1,200 to 1,400 feet deep is used. Magnesium is only one of many products made from the brine, which contains approximately 14 percent NaCl, 9 percent $CaCl_2$, 3 percent $MgCl_2$, and 0.15 percent bromine. One hundred pounds of brine contains approximately three-fourths pound of magnesium. The bromine and sodium and calcium salts are removed by evaporation, filtration, and fractional crystallization, with addition of chlorine during the process. The purified magnesium chloride solution is concentrated further by crystallization. The crystals are melted in their water of crystallization, the fused mass flaked and then air-dried until an almost anhydrous $MgCl_2$ is produced. This is electrolyzed in a sodium chloride bath. The process is continuous, and the metal, which is of high purity, is periodically dipped from the rectangular cast-steel pots in which electrolysis occurs and cast into ingots of various sizes. The methods used by the Dow Chemical Co., as described by Dr. John A. Gann in 1930 and 1932, are still in general practice, except that the final drying of the $MgCl_2$ in an atmosphere of hot hydrochloric-acid gas has been abandoned.[1] Electrolytic cells are now operated at 50,000-ampere capacity.

CONSUMPTION

Virtually all magnesium consumed in the United States is of domestic origin. Imports are insignificant, but exports are reported to be large, although exact data are not available. Owing to the lack of export data it is impossible to determine the total consumption of magnesium in this country.

Magnesium was first used in pyrotechnics, but since the domestic industry began it has found many other applications. The principal uses of the metal at present are as a deoxidizer in the metallurgical treatment of other metals and in the manufacture of alloys.

Owing to its affinity for oxygen and nitrogen, magnesium is an excellent deoxidizer or scavenger for such metals as brass, bronze,

[1] Gann, John A., The Magnesium Industry: Ind. and Eng. Chem., vol. 22, 1930, p. 694; Magnesium: Min. and Met., vol. 13, 1932, pp. 179-183.

nickel, and nickel-silver. Added to the melts of these metals it forms a lightweight magnesium oxide which rises to the surface and can be skimmed off. The amount of magnesium added usually ranges from 0.05 to 0.2 percent of the weight of the metal treated, but the total amount used accounts for an appreciable part of the magnesium consumed.

The use of magnesium in alloys is expanding more rapidly than other uses. The high-strength aluminum alloys containing 0.2 to 10.0 percent magnesium were the first to be used extensively, but in recent years alloys with high magnesium content have been increasing in importance. The combination of high strength and lightness with good machinability has contributed to the expanding market for magnesium alloys in the aircraft and transportation industries. On a volume basis, 1 pound of magnesium equals 1½ pounds of aluminum and about 5 pounds of copper. Data on the production of alloys with low magnesium content are not available, but domestic fabricators have reported sales and use of high magnesium alloys to the Bureau of Mines for several years.

Magnesium products (other than ingot and stick magnesium) manufactured in the United States and sold or used by the companies manufacturing the products, 1934–36

[This table includes only the products made from magnesium or alloys containing high percentages of magnseium. It does not include the large quantity of metal used as a deoxidizer and in alloys with low magnesium content]

Product	1934		1935		1936	
	Pounds	Value	Pounds	Value	Pounds	Value
Alloy ingot	237,693	$69,696	307,470	(1)	872,020	(1)
Structural products:						
Castings	284,419	429,974	375,625	$591,480	791,859	$939,806
Sheet	93,591	49,236	75,977	44,570	51,798	38,474
Structural shapes, rods, and tubing	94,935	48,726	49,139	26,918	[2] 71,242	[2] 82,532
Forgings	68,936	44,159	72,626	45,400	59,710	40,061
Other structural [3]	4,137	1,374	672	264	1,031	2,469
Total structural products [4]	546,018	573,469	574,039	708,632	975,640	1,103,342
Nonstructural products:						
Wire and ribbon	10,348	16,989	20,171	33,084	[2] 875	[2] 3,065
Shavings [5]	55,469	27,643	57,181	28,511	37,917	18,838
Powder [5]	22,348	37,525	22,565	38,832	27,594	49,732
Other nonstructural [3]	(3)	(3)				
Total nonstructural products [4]	88,165	82,157	99,917	100,427	66,386	71,635
Grand total (exclusive of alloy ingot)	634,183	655,626	673,956	809,059	1,042,026	1,174,977

[1] Bureau of Mines not at liberty to publish figures.
[2] Some products formerly classified as "Wire and ribbon" are included under "Structural shapes, rods, and tubing" in 1936.
[3] In 1934, small quantity of miscellaneous, unspecified, nonstructural products included under "Other structural"; separate figures not available.
[4] In 1934, small unspecified quantity of miscellaneous nonstructural products included under "Total structural products."
[5] In 1934–35, inclusive, minor quantities of shavings included under "Powder"; separate figures not available.

The quantity of structural products sold or used in the United States in 1936 increased 70 percent over 1935, whereas sales of nonstructural products decreased 34 percent; sales of alloy ingot increased 184 percent. There were 10 manufacturers of magnesium products in 1936.

Among the structural products the greatest improvement was shown in castings and extruded products, such as structural shapes,

rods, and tubings. The quantity of castings produced in 1936 increased 111 percent over 1935. Output of both die and sand castings increased in 1936. The Hoover Co. completed a new plant for the production, machining, and finishing of magnesium-alloy die castings for use in vacuum cleaners. Approximately 5,000 castings are produced daily. Die castings were also adopted in such devices as automatic hammers, binoculars, and radio-transmitting cases.

Larger quantities of sand castings were used during 1936 in aircraft-engine parts, such as crankcases, oil pans, blower sections, rear accessory cases, oil pumps, and cam-shaft bearings and in other airplane equipment, such as landing wheels, cockpit fittings, and automatic-pilot parts. More sand castings were used for needle bars and other moving parts in textile machinery, bread slicing and wrapping equipment, ventilating fans, safety blocks used in die presswork, foundry flasks, patterns, core boxes, match plates, motion-picture cameras, addressing machines, and welding equipment. New uses developed for sand castings included parts for shoemaking, printing, and

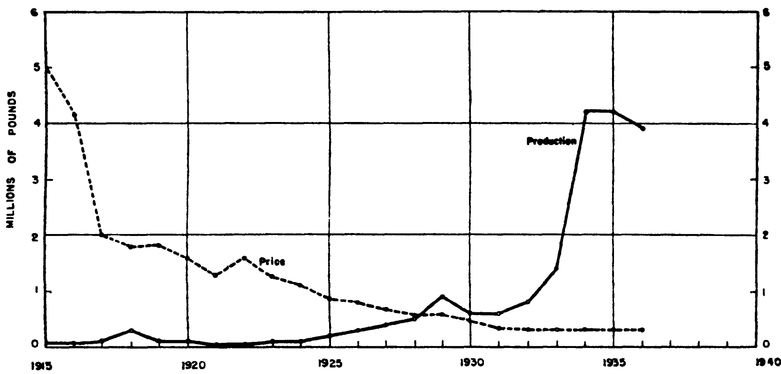


FIGURE 41.—Trends in quoted price and production of magnesium in the United States, 1915–36.

cigarette-making machinery, duplicators, scales, spray guns, mimeographs, and musical instruments of the percussion type.

The value of magnesium castings averaged $1.19 per pound in 1936 compared with $1.57 in 1935.

During 1936 the manufacture of magnesium extruded products increased 45 percent over 1935. Round, square, hexagonal, and rectangular bars, structural shapes, and moldings of complex shapes were employed for stressed members of rapidly moving equipment, for coach-seat parts, and as screw-machine stock.

In the process of development are uses for magnesium in the making of welded oil tanks for aircraft, etching plates for the printing industry, parts of military utility carts and gun carriages, magnesium-alloy forgings for use as aircraft propellers, and magnesium castings, extrusions and rolled sheets in bus and coach manufacture.

The high-magnesium alloys are known in the world trade by various names, such as Magnalium, Dowmetal, Elektron, AM Alloys, Bohnalite X, Hydronalium, and Maxium.

PRICES

According to the Engineering and Mining Journal Metal and Mineral Markets the nominal New York price for 99.8-percent ingot magnesium remained unchanged at 30 cents per pound, carload lots,

throughout 1936. Quotations for less than carload lots, 100 pounds or more, were 32 cents per pound, with a premium of 5 cents a pound over ingot price for specified stick sizes (¼, ⅜, ½, 1, and 2 pounds each). The four notched ingots commonly furnished are 4 by 4 by 28 inches and weigh approximately 17 pounds. Alloy ingot is normally quoted at 3 cents per pound more than pure magnesium ingot. London quotations for magnesium ingot and stick remained at 1s. 6d. to 1s. 7d. per pound during 1936.

FOREIGN TRADE

Imports of magnesium are unimportant. Imports of powder were 1,108 pounds valued at $1,453 in 1936, compared with 882 pounds valued at $1,252 in 1935. Imports of sheets, tubing, ribbons, wire, and other magnesium products totaled 18 pounds valued at $26 in 1936 compared with 2 pounds valued at $40 in 1935. Exports of magnesium, mainly as ingot, are not separately recorded but have been relatively large since 1933. Reports state that 2,000,000 pounds of Dowmetal were sold to Europe during the first 6 months of 1935.

TECHNOLOGIC DEVELOPMENTS

An improved process for the manufacture of magnesium is said to have been developed in Austria.[2] Magnesium oxide, obtained by calcining magnesite or dolomite, is reduced by carbon in an electric furnace at a temperature of about 2,000° C., which is well above the boiling point of magnesium metal. The metallic vapor, which leaves the furnace mixed with carbon gases, is filtered from accompanying dust and rapidly cooled to 200° C. The cooled product, comprising a mixture of magnesium metal, oxide dust, and soot, is heated to 800° to 1,000° C. in an electric furnace under partial vacuum (20 to 100 mm mercury) in the presence of hydrogen or methane. Here the magnesium is again vaporized and cooled to the liquefying but not to the solidifying point. The liquefied metal falls in drops into a bath of hydrocarbon oil of high boiling point. The oil causes the drops to coalesce into granules 10 to 20 mm in diameter and at the same time separates any dust, so that the metal isolated is about 99.97 percent pure. The metal and dust can be separated easily and independently from the oil. Aluminum or silicon, or a mixture of the two, can be used as the reducing agent instead of carbon, thereby eliminating the formation of gases so that only magnesium vapor escapes from the furnace. This new method produces a metal free from injurious salts. It is said that producing units of 5,000 to 10,000 kw.-hr. capacity are possible with this process.

Much progress has been made in developing new magnesium alloys and they have been well described in recent literature.[3]

The founding of magnesium alloys is the subject of a recent paper by Gann and Brooks.[4]

[2] New Process for Magnesium; Canadian Chem. and Met., vol. 20, no. 6, June 1936, p. 204.

[3] Gann, John A., Magnesium and Magnesium Alloys; Handbook of Engineering Fundamentals, by Eshbach, Ovid W., 1936, pt. 11, pp. 75–79

American Society for Metals, Metals Handbook, Cleveland, 1936.

Woldman, N. E., and Dornblatt, A. J., Engineering Alloys; American Society for Metals, Cleveland, 1936.

American Society of Civil Engineers, Structural Application of Steel and Light-Weight Alloys, A Symposium: Proc., vol. 62, no. 8, pt. 1, 1936.

Aluminium Laboratories, Ltd., Abs. Bull., Geneva.

[4] Gann, John A., and Brooks, M. E., Founding Magnesium Alloys: Paper presented at 1935 Convention of Am. Foundrymen's Assoc., Toronto, Canada, 24 pp.

153336—37——47

Magnesium-alloy die castings have been improved as a result of technical progress. The old gooseneck machine has been supplanted by modern, hydraulically operated, plunger-type machines similar to those used in the brass industry.

A new alloy has been developed that can be heat-treated after it has been shaped by extrusion and press forming. It has improved yield strength and good corrosion resistance.

Chemical treatment of magnesium alloys has proved the most satisfactory method for increasing corrosion resistance under saline conditions. The most widely used treatment consists of a dip in a nitric acid-sodium dichromate solution.[5] This chrome-pickle treatment when properly applied protects the alloy well from corrosion and makes it an excellent paint base, but as the treatment reduces the cross section of the metal it cannot be used on dimension-machined surfaces. The alkaline chromate treatment[6] can be used on such surfaces but gives inferior protection against corrosion. The National Bureau of Standards reports the perfection of a process combining the desirable features of both methods. This process consists of cleaning the metal in an electrolytic bath of sodium carbonate and trisodium phosphate then treating it in an anodic bath containing 10 percent sodium dichromate and 2 to 5 percent monosodium phosphate.[7]

The United States Bureau of Mines is investigating the production of magnesium from magnesites of the Northwest. A series of flotation tests is in progress on the beneficiation of crude and calcined magnesite. Separation of magnesia and silica in the calcined product is being attempted by flotation. After a study of the literature it has been concluded that two methods offer the best possibilities for profitable extraction of magnesium from magnesite ores: Chlorination of technically pure MgO by heating it with carbon and chlorine, followed by electrolysis of the fused chloride; and direct electrothermic reduction of calcined magnesite by carbon and purification of the product by redistillation. Experiments are being conducted with the latter method.

WORLD PRODUCTION

The production and fabrication of magnesium have advanced rapidly during the past few years, but published details of processes, output, and general progress are not available. Germany continues to retain the title of the world's chief producer of metallic magnesium and its output probably surpasses that of the rest of the world combined. Most of the metal has been produced by electrolysis of magnesium chloride, about two-thirds of which is derived from magnesite and dolomite, while the rest comes from brines and carnallite. World magnesium production has been estimated at 30,000 to 35,000 metric tons in 1934 and about 50,000 tons in 1935. A more conservative estimate would probably be about 9,000 metric tons in 1934; 11,000, in 1935; and 15,000, in 1936. The world producers in apparent order of importance are Germany, United States, France, Switzerland, United Kingdom, Japan, U. S. S. R. (Russia), and Austria.

[5] Winston, A. W., Reid, J. B., and Gross, W. H., Surface Preparation and Painting of Magnesium Alloys: Ind. and Eng. Chem., vol 27, 1935, p. 1333.

[6] Sutton, H. and LeBrocq, L. F., Chemical Treatment No. 3—Magnesium-Base Alloys: Bur. of Aeronautics, Navy Dept., Spec. M-303, pt. 2, June 1936.

[7] Buzzard, R. W., and Wilson, J. H., Anodic Coating of Magnesium Alloys: Bur. of Standards, Jour. Research, vol. 18, RP964, 1937, pp. 83-87.

Australia.—Further negotiations for the production of magnesium are contemplated by the Australia Magnesium Co. of Hobart, Tasmania, which carried on some experimental work with dolomite about 1935.

Austria.—The Österreichisch-Amerikanische Magnesit A. G. (Austro-American Magnesite Co.) has an experimental plant for the production of magnesium at Radenthein, Carinthia, about 6 miles south of its magnesite mines. This pilot plant, with a daily capacity of 770 pounds has been operated intermittently since 1930. The process is described in this chapter under Technologic Developments. The construction of a commercial plant is anticipated.

Although official statistics are not available it is reliably reported that 2,697 kilos (5,933 pounds) of magnesium were imported in 1936 from German ports, Switzerland, and the United Kingdom. Approximately 10,000 metric tons of crude magnesite are shipped annually from the Zillerthal mine to the I. G. Farbenindustrie plant at Bitterfeld, Germany, to be converted into magnesium. This ore has less than 1½ percent of iron, and 4 tons of the crude magnesite are said to produce 1 ton of metallic magnesium. Austria supplies magnesite to many other countries for the production of magnesium.

Canada.—No magnesium has been produced in Canada since the World War, when the Shawinigan Electro-Metals Co., Ltd., was a producer at Shawinigan Falls, Quebec. The company no longer exists, and the plant has been dismantled.

France.—The principal producers of magnesium are Compagnie Alais, Forges et Camarque (Péchiney) at Saint-Auban (Basses Alpes) and Société d'Electrochimie, d'Electrometallurgie et des Acieries Electriques d'Ugine at Jarrie (Isère). The Société Générale du Magnésium is the exclusive fabricating and sales agency for these two firms. Smaller quantities of the metal are produced by the Société Bozel-Maletra at Villard (Haute Savoie) and other companies.

The raw materials utilized in magnesium production are magnesite, carnallite, and dolomite. Carnallite and dolomite are found in abundance in France, but magnesite must be imported from Greece and the Tyrol, Austria.

According to unofficial figures the French magnesium output increased from about 100 metric tons in 1932 to more than 1,300 in 1936. Consumption, with which production has kept pace, was estimated at 80 metric tons in 1932, 200 in 1933, 300 in 1934, 700 in 1935, and 1,200 in 1936. Imports of magnesium are said to have totaled 61 metric tons in 1931, 24 in 1932, 7 in 1933, 5 in 1934, 20 in 1935, and 19 in 1936, most of which came from Germany, Switzerland, United Kingdom, and the United States. Magnesium exports are reported as 6 metric tons in 1931, 1 each in 1932 and 1933, 20 in 1934, and 80 each in 1935 and 1936 and are consigned to Central Europe, U. S. S. R. (Russia), and the United Kingdom.

Germany.—The Bitterfeld plant of I. G. Farbenindustrie is the largest producer of metallic magnesium in the world. The other German producer, Wintershall A. G., Heringen-Wintershall, began operations in 1934 and uses carnallite ($KMgCl_3.6H_2O$) as the raw material; its 1935 output was 4 to 5 tons per day.

The Bitterfeld plant is said to have used carnallite as the raw material until 1932, when it changed to imported magnesite. Recent reports, however, indicate that the I. G. Farbenindustrie is gradually

reverting to carnallite and dolomite, both domestic materials.[8] The production of magnesium from carnallite is a discontinuous process and apparently comprises fractional crystallization of magnesium chloride from the natural salt, drying by hydrochloric-acid gas or chlorine, and electrolysis.[9] The magnesia process consists of the chlorination of dead-burned magnesite at a high temperature in the presence of special grades of carbon. The resultant $MgCl_2$ is decomposed electrolytically to produce magnesium and chlorine; the latter is used again in the exothermic reaction,

$$MgO+C+2Cl=MgCl_2+CO$$

It is stated that 18 tons of carnallite yields 10 tons of calcined product which in turn yields 1 ton of magnesium. Dolomite also is used as a raw material at Bitterfeld; its use was made possible by the invention of a method for distilling the crude metal obtained by thermal reduction of magnesia with coal. This method is probably similar to that used in Austria.

Official statistics on German magnesium production and foreign trade have never been revealed. The annual output was estimated at 2,000 metric tons prior to 1933, but later estimates range from 25,000 metric tons in 1934 to 35,000 in 1935. These figures are probably too high, and more conservative estimates indicate that the annual output in recent years has not exceeded 8,000 tons. Domestic output of magnesite increased from 5,700 metric tons in 1933 to 13,800 in 1935, and imports increased from 53,388 tons in 1933 to an estimated 150,000 in 1936. The amount of magnesite consumed by the magnesium industry is not known. It is believed that exports of magnesium and its alloys are considerable, but probably they have not exceeded 3,000 tons annually during the last 5 years.

Italy.—The Montecatini group has obtained authorization from the Government to construct a plant for the production of magnesium at Porto Marghera. Initial plans are to produce 150 tons a year, using magnesite. The Minerals Chemicals of Sulcis in Sardinia, controlled by Isotta Fraschini, is reported recently to have begun the production of magnesium. Presumably magnesium-bearing brines, obtained from the evaporating ponds for sea salt at Cagliari, are used as the raw material. Italy has dolomite in Tuscany and the Dolomites, and magnesite in Sardinia.

Japan.—The only commercial producer of magnesium in Japan is the Nichiman Magnesium Kabushiki Kaisha (Japan-Manchukuo Magnesium Co., Ltd.), which merged with the Riken Magnesium K. K., the South Manchurian Railway and other interests in October 1933, acquiring the 150-ton magnesium plant at Naoetsu in Niigata Prefecture. Besides this plant, which uses sea water bittern, it owns the recently constructed 700-ton capacity plant at Ube in Yamaguchi Prefecture. Two processes are used at this plant, and the chlorine gas, recovered from the electrolysis of magnesium chloride derived from sea water bittern by dehydration in one process, is utilized in the second electrolytic process employing calcined magnesite. Expansion of the Ube magnesium plant to 1,000-ton capacity by the end of 1937 will permit closing the Naoetsu works. One metric ton of magnesium requires from 17 to 20 tons of solid bittern and about 50,000 kilowatts of power.

[8] U. S. Bureau of Mines, Mineral Trade Notes: Vol. 4, no. 3, Mar. 20, 1937, pp. 8–10.
[9] L'Industrie Chimique, (French), The Fabrication of Magnesium and of Magnesia: 1936, p. 802.

The Nippon Magnesium Kinzoku K. K. (Japan Magnesium Metal Co., Ltd.) built a magnesium plant in Konan, Korea, in 1934, using the thermal reduction process, with near-by magnesite as the raw material. This plant, still in the experimental stage, plans an annual capacity of 2,000 metric tons. The Asahi Denka Kogyo K. K. (Asahi Electro-Chemical Industry Co., Ltd.) is experimenting with its own process of electrolyzing calcined magnesite and contemplates a 350-ton annual capacity. The Nippon Soda K. K. (Japan Soda Co., Ltd.) proposes an annual production of 300 tons by the electrolysis of calcined magnesite.

Japanese magnesium production was 3,219 kilograms in 1931, 24,018 in 1932, 104,812 in 1933, and 140,808 in 1934. All official data terminated after 1934, but output is estimated at 350,000 kilograms in 1935 and 650,000 in 1936. Japanese imports were 8,996 kilograms in 1930, 8,328 in 1931, 19,328 in 1932, 25,515 in 1933, and 617 in 1934, principally from Germany. There were probably no imports in 1935 and 1936, and Japan began exporting magnesium in 1934, shipping 3,502 kilograms to the United Kingdom.

Norway.—The Norwegian Salt Works near Bergen ceased production of magnesium some years ago.

Switzerland.—Magnesium has been produced from magnesite and dolomite by the S. A. pour la Fabrication du Magnésium at Martigny since 1926. Magnesite is imported chiefly from Germany, the Netherlands, and Austria. Domestic dolomite is available in the Cantons of Tessin and Vaud. Estimated output for 1936 is about 700 metric tons.

U. S. S. R. (Russia).—By the end of 1936 Russia had 15 furnaces in operation for the production of magnesium from carnallite at the Solikamsk works in the Ural Mountains. The recently completed Dnepr plant at Neproges uses magnesium chloride obtained from the Saki Lakes, Crimean Peninsula. The Leningrad Experimental Magnesium Metal Plant at Leningrad is investigating production of the metal from magnesite and dolomite.

United Kingdom.—Magnesium Metal & Alloys, Ltd., Rainham, Essex, began to produce magnesium in April 1935 and is now extending its plant to increase output. The company is under the control of Murex, Ltd., which is purchasing the interest of Messrs. Johnson, Matthey & Co. The former alinement of interests that included this concern disbanded in October 1936.[10] Magnesium Elektron, Ltd., at Clifton Junction near Manchester, formed early in 1936 by F. A. Hughes & Co., London, holds the magnesium production and fabrication of patents of I. G. Farbenindustrie. Production was begun early in 1937, and an initial output of 150 tons monthly was planned. Both companies use magnesite imported chiefly from Austria and Greece. The Imperial Magnesium Corporation, Ltd., owned jointly by the British Aluminium Co., Ltd., and the Imperial Smelting Corporation, is now erecting a plant at Swansea, England, to produce magnesium. It has acquired a license to use the Austrian thermal reduction process and plans a plant with a final capacity of 7,000 tons annually.

Other countries.—Production of metallic magnesium has been proposed in the Netherlands and Poland.

[10] Imperial Institute, London, World Production of Magnesium: Bull., vol. 34, no. 4, October-December 1936, pp. 453–458.

ANTIMONY AND CADMIUM

By Elmer W. Pehrson and John B. Umhau [1]

SUMMARY OUTLINE

ANTIMONY

Apparent consumption of primary antimony in the United States in 1936, reflecting the general improvement in business, increased 80 percent over that of 1935 and was the largest recorded since 1929. Imports were 85 percent higher and continued to be the chief source of supply. Domestic mines produced 29 percent more antimony than in 1935, but contributed only 10 percent of the total consumption. Price fluctuations were not so pronounced as in 1935. The average New York quotation for Chinese brands was lower—12.97 cents per pound compared with 14.08 cents in 1935. The average for domestic brands was 12.25 cents in 1936 and 13.62 cents in 1935. Late in 1936 prices of nearly all metals moved upward in response to an unusual demand that developed in Europe and the United States. Antimony prices shared in this movement, and by March 1937 the New York quotation had exceeded 16 cents, notwithstanding the fact that the leading producer in the United States previously had announced its desire to keep the maximum price below 14 cents and the average price at 12 cents.

World production increased 15 percent despite a decline in output in China, whose contribution to the world total dropped from 71 percent in 1929 to 53 percent in 1936. Mexico and South America made notable advances in production in 1936.

The Chinese industry was affected adversely by political conditions. Apparently the first year of control of the industry by the National Government was unsuccessful, as reports indicate considerable friction between the Antimony Administration, dealers, and producers. During the latter part of 1936 dealers at Changsha engaged in a speculative orgy, which prompted the Administration early in 1937

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

to adopt drastic measures of control in an endeavor to stabilize the market. Producers retaliated by withholding supplies, and reports for April indicated that shipments of metal from Changsha had ceased.

Salient statistics for antimony in the United States, 1932–36

	1932	1933	1934	1935	1936
Production of antimony ore and concentrates ..... short tons..	900	1,133	897	[1] 3,616	3,867
Antimony contained ..... do....	419	587	404	[1] 559	755
Antimony content of antimonial lead produced from domestic and foreign ores ..... short tons..	1,085	927	1,675	1,136	1,471
Secondary antimony produced ..... do....	6,450	7,400	7,550	9,600	9,900
Imports for consumption:					
Antimony in ore ..... do....	1,328	2,128	2,891	4,587	10,545
Liquidated antimony sulphide ..... do....	435	707	417	1,352	1,185
Metal ..... do....	1,508	1,934	1,765	1,248	1,170
Oxide ..... do....	403	651	269	594	1,201
Exports of foreign antimony ..... do....	123	98	402	318	391
Primary antimony available for consumption..do....	4,272	6,021	7,262	8,351	15,038
Stocks of antimony in bonded warehouse at end of year ..... short tons..	705	523	570	830	443
Average price for year of antimony at New York [2] ..... cents per pound..	5.62	6.51	8.92	[3] 14.08	[3] 12.97
World production ..... short tons..	19,100	21,500	23,600	29,800	34,200

[1] Revised figures.
[2] According to American Metal Market.
[3] Chinese grade. American grade was quoted at 13.62 cents a pound for 1935 and 12.25 cents for 1936.

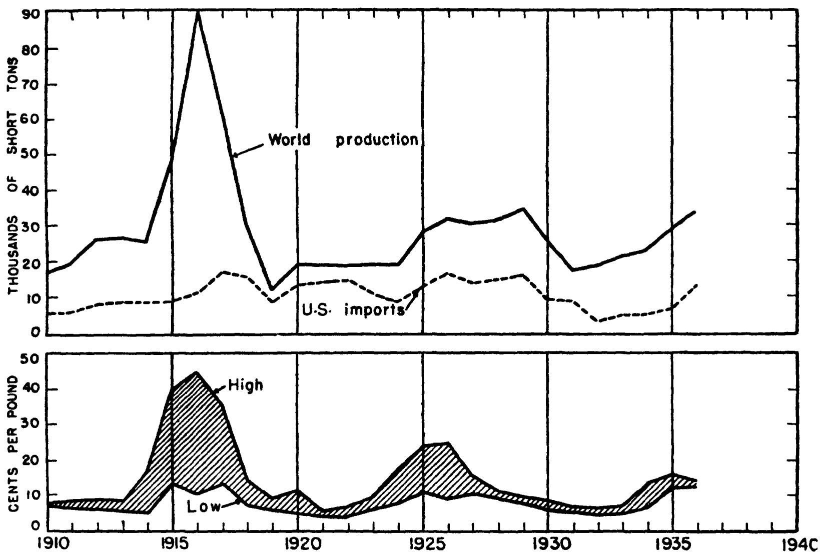


FIGURE 42.—Trends in world production, United States imports, and New York price of antimony, 1910-36.

The strategic position of the United States with respect to antimony recently underwent an important change. In 1929 about 70 percent of all antimony imported came from China, whereas in 1936 less than 10 percent was of Chinese origin and about 90 percent came from Mexico and South America. Coincident with this shift in source was a change in the nature of the products imported. About 70 percent of the 1929 shipments was regulus and 11 percent was ore, whereas in 1936, 76 percent was ore and only 8 percent was metal. This change was made possible by an increase in smelting capacity in the United States, which enlarged the market for Mexican, South

American, and, to a smaller extent, domestic ores. The domestic industry can now supply large tonnages of metal and oxides to the trade.

From a military viewpoint, dependence on American sources of supply is preferable to dependence on Asiatic sources, because in an emergency the former could be maintained more easily than the latter. One important factor, however, which has not been investigated thoroughly, is the adequacy of antimony reserves in North and South America. This is important, as it involves the permanence of the present domestic industry. Obviously, the Chinese, with their abundant and rich deposits, will not permit the loss of the world's largest market without a struggle.

DOMESTIC PRODUCTION

Mine output.—Antimony mined in the United States is derived from both antimony ores and lead ores, the latter being the more important source. Byproduct antimonial drosses obtained in refining lead bullion are used in the manufacture of antimonial lead, other alloys, and various antimony compounds such as oxides and sulphides. In 1936, 1,434 tons of antimony derived from domestic lead and antimony ores were recovered in antimonial lead; data on the quantity recovered in other alloys and compounds are not available.

The antimony content of antimony ores and concentrates produced in 1936 was the highest recorded since 1916. Of the 755 tons reported, 729 were contributed by the Yellow Pine Co. in Valley County, Idaho. The remainder was supplied by three small producers in Nevada and one in Washington. The Arkansas Antimony Corporation, De Queen, Ark., began mining early in 1937. No production was reported from Alaska in 1936; but Morris P. Kirk & Son, Inc., an affiliate of the National Lead Co., acquired the Stampede mine in the Kantishna district and began shipping ore early in 1937.

Mine production of antimony ores and concentrates in the United States, 1932–36, in short tons

Year	Ore and concentrates	Antimony content	Year	Ore and concentrates	Antimony content
1932	900	419	1935	[1] 3,616	[1] 559
1933	1,133	587	1936	3,867	755
1934	897	404			

[1] Revised figures.

Smelter output.—The only active primary antimony smelter in the United States is that of the Texas Mining & Smelting Co. at Laredo, Tex., which treats largely Mexican ores. The plant, which produces antimony oxide in addition to metal, was put into operation at the beginning of 1931. Its annual output has been as follows:

Antimony produced by the Texas Mining & Smelting Co., 1931–36, in short tons

Year	Antimony metal	Antimony oxide	Year	Antimony metal	Antimony oxide
1931	2,201	577	1934	1,797	517
1932	1,775	100	1935	2,134	1,007
1933	1,204	68	1936	3,451	1,423

Except for 1933 and 1934, when one other company was producing, the foregoing statement of antimony-metal production represents the entire domestic output since 1929. Additions to the Laredo smelter, completed in 1937, have increased the monthly capacity to 900 tons. This may be varied, according to demand, between 900 tons of metal with no oxide and 600 tons of metal with 300 tons of oxide.

Details of antimonial lead production at primary lead refineries are shown in the accompanying table. These represent only part of the total antimonial lead output, as large quantities are produced at plants that operate exclusively on scrap, and some hard lead is made by mixing antimony and soft lead.

Antimonial lead produced at primary lead refineries, 1929–36

Year	Production (short tons)	Antimony content				
		From domestic ores (short tons)	From foreign ores [1] (short tons)	From scrap (short tons)	Total	
					Short tons	Percent
1929	43,244	2,311	741	1,883	4,935	11.9
1930	24,797	1,302	383	1,282	2,967	12.0
1931	21,842	768	196	1,474	2,438	11.2
1932	21,024	878	207	1,410	2,495	11.9
1933	17,805	870	57	793	1,720	9.7
1934	16,607	1,657	18	588	2,263	13.6
1935	16,384	1,110	26	593	1,729	10.6
1936	23,230	1,434	37	691	2,162	9.3

[1] Includes lead ores, antimony ores, and metallic antimony.

Secondary production.—The following table shows the total amount of secondary antimony recovered in the United States from scrap. Additional information is given in the chapter entitled "Secondary Metals."

Secondary antimony recovered from old alloys, scrap, and dross, in the United States, 1932–36

Year	Short tons	Value [1]	Year	Short tons	Value [1]
1932	6,450	$725,000	1935	9,600	$2,703,400
1933	7,400	963,500	1936	9,900	2,568,100
1934	7,550	1,346,900			

[1] Values calculated at average yearly price for ordinary brands of antimony as published by the American Metal Market.

DOMESTIC CONSUMPTION

Precise data on the consumption of primary antimony in the United States are not available owing to lack of information on dealer and consumer stocks. An approximate idea of the trend of consumption, however, can be obtained from the following table, which shows the annual supply available for consumption.

Primary antimony available for consumption in the United States, 1929–36, in short tons

	1929	1930	1931	1932	1933	1934	1935	1936
Domestic antimony recovered in antimonial lead	2,311	1,302	768	878	870	1,657	1,110	1,434
Imports for consumption (antimony content):								
Antimony ore	1,865	863	4,863	1,328	2,128	2,891	4,587	10,545
Liquated sulphide [1]	1,262	499	455	304	495	292	946	830
Compounds [2]	1,778	626	666	377	563	241	502	974
Type metal, etc	295	53		1	301	586	209	309
Regulus	11,073	7,700	3,753	1,508	1,934	1,765	1,248	1,170
Total available	18,584	11,043	10,505	4,396	6,291	7,432	8,602	15,262
Exports under draw-back	57	174	107	124	270	170	251	224
Available for consumption	18,527	10,869	10,398	4,272	6,021	7,262	8,351	15,038

[1] Content estimated at 70 percent.
[2] Content estimated at 80 percent.

A notable increase in consumption of antimony in 1936 is indicated by the 80-percent rise in the available supply of primary metal. This was brought about largely by an improved demand for antimonial lead and other alloys, although the manufacture of antimony compounds also consumed greater tonnages. In 1936, 4,852 tons of antimony oxide and other compounds, with an estimated antimony content of 3,940 tons, were produced, compared with 3,969 and 3,227 tons, respectively, in 1935.

Over half of the primary antimony consumed in the United States is used in the manufacture of such products as storage batteries, cable covering, and bearing metals, from which there is a large return of scrap. The constant recycling of this scrap provides industry with antimony products in addition to those made from primary metal. In 1936, 9,900 tons of secondary antimony were recovered, which was equivalent to 66 percent of the apparent consumption of new metal.

Some important changes have been made recently in the manufacture of electric storage batteries, one of the principal consumers of antimony. Due to greater load requirements of modern automobile batteries, the thickness of grids has been reduced to permit use of more plates without increasing the size of the battery. This has necessitated an increase in the tensile strength of the antimonial lead used for this purpose, which has been done by increasing the antimony content to 12 percent; formerly 6 to 9 percent was used. It has been known for some time that small amounts of the antimony in storage batteries enter the electrolyte and cause self-discharge of the battery when idle. This has not been troublesome in automobile batteries, but in some other installations it is a distinct disadvantage. To overcome this difficulty, lead alloy containing 0.1 percent calcium has been developed. Its adoption for use in automobile batteries is uncertain, as it is difficult to cast the alloy into the thin grids now required, and heat treatment is needed to provide strength equivalent to the antimonial lead grids now used. A cadmium-lead alloy is being used in submarine storage batteries in Germany.

The use of antimony fluoride as a mothproofing for fabrics has been described.[2] Antimony is said to be superior to arsenic as a preventive

[2] Textile Colorist, vol. 58, September 1936, p. 591.

of dezincification in the manufacture of copper-bearing-metal alloys containing zinc. A pewter composed of 5 percent antimony and 95 percent tin and with properties superior to those of the commonly used alloy of 2 percent copper, 6 percent antimony, and 92 percent tin, has been developed.

FOREIGN TRADE

The following tables show imports and exports of antimony and antimony products.

Antimony imported for consumption in the United States, 1932–36

Year	Antimony ore			Liquated antimony sulphide		Antimony metal		Antimony oxides and other compounds	
	Short tons	Antimony content		Short tons	Value	Short tons	Value	Short tons	Value
		Short tons	Value						
1932	3,679	1,328	$74,397	435	$14,452	1,508	$108,241	471	$42,014
1933	5,445	2,128	106,662	707	42,727	1,934	137,541	704	59,559
1934	8,455	2,891	158,672	417	26,761	1,765	158,414	301	35,507
1935	14,205	4,587	544,608	1,352	165,446	1,248	250,771	628	94,783
1936	30,486	10,545	1,200,132	1,185	139,784	1,170	243,474	1,218	217,505

Antimony imported for consumption in the United States, 1935–36

Country	Antimony ore			Antimony metal	
	Gross weight (short tons)	Antimony content		Short tons	Value
		Short tons	Value		
1935					
Argentina	413	253	$31,333		
Belgium				1	$295
Bolivia	540	350	40,388		
Chile [1]	360	227	27,303		
China				723	117,123
Honduras	12	5	707		
Hong Kong	28	20	1,450		
Mexico	12,483	3,493	402,225	507	127,689
Panama	93	65	12,507		
Peru	276	174	28,695		
United Kingdom				17	5,664
	14,205	4,587	544,608	1,248	250,771
1936					
Argentina	1,611	1,035	156,812		
Belgium				58	11,937
Bolivia	1,108	627	83,324		
Canada	(2)	(2)	32		
Chile [1]	2,020	1,241	189,455		
China	211	123	12,660	738	138,310
Hong Kong	56	31	3,165		
Mexico	24,704	6,991	687,651	351	86,573
Panama	15	10	2,126		
Peru	761	487	64,907		
United Kingdom				23	6,654
	30,486	10,545	1,200,132	1,170	243,474

[1] Imports credited to Chile originated mainly in Bolivia.
[2] Less than 1 ton.

Estimated antimony content in type metal, antimonial lead, and other alloys imported for consumption in the United States, 1929–36, in short tons [1]

Year	Type metal and antimonial lead	Other alloys [2]	Total	Year	Type metal and antimonial lead	Other alloys [2]	Total
1929	295		295	1933	4	297	301
1930	53		53	1934	18	568	586
1931				1935	89	120	209
1932	1		1	1936	[3] 56	253	309

[1] For details of gross weight and values see imports shown in Lead chapter.
[2] Chiefly in special antimony-lead alloys containing high percentage of antimony, importation of which was begun in 1933.
[3] Type metal only.

Foreign antimony (regulus or metal) exported from the United States, 1932–36

Year	Short tons	Value	Year	Short tons	Value
1932	123	$11,820	1935	318	$62,167
1933	98	9,321	1936	391	56,308
1934	402	42,415			

PRICES

The average New York price for Chinese antimony in 1936 was 12.97 cents per pound (duty paid), a decline of 8 percent from 1935. The quotation at the beginning of the year stood at 14 cents, which proved to be the high for the year. The downward trend evident in the last quarter of 1935 continued into 1936. Weakness in the Chinese market was reflected in the sharp decline in New York quotations to 12.625 cents during the first part of January, but toward the latter part of the month the market strengthened and by March the price had risen to 13.50 cents, at which level it remained throughout April and May. During June, however, political conditions in China prompted some liquidation of stocks held at Changsha, and by the early part of August the New York price had declined to 12.50 cents, the low for the year. There was no change during September, October, and November, but early in December the price began to move upward, largely on account of general consumer and speculator interest in other nonferrous metals. At the close of the year the quotation stood at 13.75 cents.

Quotations for domestic metal ranged from 10.625 cents in August to 13.75 cents at the close of the year and generally were below the quotations for Chinese metal. The average price for American brands during 1936 was 12.25 cents, or 0.72 cent below the average quotation for Chinese brands.

On the London market quotations on English brands ex warehouse opened at £76 to £77 per long ton and closed at £72 to £73. The opening price was also the high for the year, and the low of £64½ to £65½ was established during the latter part of July and held during August and September. Price ranges on foreign brands ex warehouse were as follows: Open and high £65, low £51, and close £60 to £61. In China, prevailing prices for antimony c. i. f. Hankow were considerably higher at the close of the year than at the beginning. On December 31, 1935, the price was equivalent to $214 (U. S. currency) per long ton, compared to $236 on December 31, 1936. At the end of July the quotation stood at $183.

Average monthly quoted prices of antimony, prompt delivery at New York, 1929–36, in cents per pound [1]

Month	Chinese brands (duty paid)								American brands [2]	
	1929	1930	1931	1932	1933	1934	1935	1936	1935	1936
January	9.55	8.59	7.34	6.01	5.70	7.21	14.36	12.96	14.11	12.74
February	9.50	8.88	7.08	6.55	5.73	7.17	14.50	13.05	14.25	12.99
March	9.53	8.27	7.12	6.19	5.95	7.54	14.50	13.42	14.25	13.07
April	9.51	7.75	6.88	5.82	5.84	7.92	14.30	13.50	14.04	12.67
May	8.94	7.45	6.52	5.21	6.25	8.49	13.91	13.50	12.73	12.41
June	8.83	7.08	6.30	5.03	6.48	7.89	12.75	13.20	12.50	11.72
July	8.45	6.98	6.81	5.00	7.16	8.02	12.75	13.00	12.50	11.24
August	8.77	7.82	6.61	5.18	7.04	8.52	12.93	12.57	12.50	11.12
September	8.68	7.76	6.53	5.60	6.88	8.76	13.54	12.50	13.22	11.76
October	8.54	7.32	6.52	5.61	6.83	9.39	15.62	12.50	15.34	12.07
November	8.50	7.11	6.68	5.79	7.07	12.38	15.30	12.50	14.19	12.21
December	8.43	7.10	6.26	5.42	7.24	13.81	14.54	12.93	13.84	12.95
Average	8.94	7.67	6.72	5.62	6.51	8.92	14.08	12.97	13.62	12.25

[1] Source: Metal Statistics, 1937.
[2] No quotations published prior to 1935.

WORLD PRODUCTION

World production of antimony in 1936, stimulated by the high prices of the past 2 years, increased 15 percent over that in 1935. The estimated production of 31,000 metric tons in 1936 almost equaled

World production of antimony, in 1929 and 1932–36, in metric tons [1]
[Compiled by R. B. Miller]

Country	1929	1932	1933	1934	1935	1936
North America:						
Honduras					5	1
Mexico	3,096	[2] 1,388	[2] 1,559	2,134	3,656	5,843
United States		304	426	293	405	548
South America:						
Bolivia [3]	3,023	1,176	1,517	961	1,633	3,090
Peru	[3] 86	[3] 14	32	134	260	628
Europe:						
Austria	560					125
Czechoslovakia	556	480	1,090	928	1,637	(4)
France	1,021	510	312	202	(4)	(4)
Greece	55	262	110	73	29	(4)
Italy	306	302	291	249	363	(4)
Yugoslavia	210				73	592
Asia:						
Borneo, British					20	(4)
China [5]	[3] 22,401	12,468	13,800	15,548	17,700	16,391
Chosen		3	8		2	(4)
India, British	38				15	(4)
Indochina					16	5
Japan	22	16	32	26	47	(4)
Turkey (Asia Minor)	6		36	53	103	(4)
Africa:						
Algeria	114	214	80	529	810	983
Morocco:						
French					110	79
Spanish	[3] 180	121	120	247		(4)
Southern Rhodesia						153
Union of South Africa					4	15
Oceania:						
Australia:						
New South Wales	25	61	42	10	24	(4)
Queensland			(6)			7
Victoria	1				93	(4)
	31,700	17,300	19,500	21,400	27,000	31,000

[1] Approximate recoverable metal content of ore produced (80 percent of reported content), exclusive of antimonial lead ores.
[2] Includes antimony content of antimonial lead.
[3] Exports.
[4] Data not available, estimate included in total.
[5] Figures represent antimony content of regulus, crude antimony, and oxide exported.
[6] Less than 1 ton (434 kilos).

the 1929 output. Statistics shown herein do not include antimony derived from lead ores, which probably seldom exceeds 5,000 tons per year. China's output decreased slightly, but in 1936 it continued to be the principal producer, having contributed 53 percent of the estimated total; in 1929 China's share was 71 percent. Loss of markets in the United States has been the principal reason for the decline in China's importance in the antimony trade. Mexico, Bolivia, Peru, Yugoslavia, and the United States mined considerably more antimony in 1936 than in 1935.

REVIEW BY COUNTRIES

Austria.—In October 1936 it was reported that operations had been resumed at the Szalonak mines in the Burgenland district.

Australia.—Wiluna Gold Mines, Ltd., completed a lead smelter to treat stibnite concentrates from the Moonlight mine, arsenopyrite from the Wiluna mine, and lead ores from mines recently acquired at Northampton, Western Australia.

China.—Over 95 percent of the antimony produced in China comes from the Province of Hunan. As the industry is important in the economic life of the Province, the decline in the price of antimony during the depression caused considerable hardship. With a view to ameliorating the situation, the Provincial Government early in 1933 organized the Antimony Trade Association for Hunan, later known as Hunan Antimony Syndicate. The syndicate was established for the purpose of collecting taxes for the Provincial Government and to exercise control over the industry. The latter objective did not prove to be very effective. Several unsuccessful attempts were made to restrict production and maintain prices. In December 1935 the National Government of China assumed control of the industry, abolishing the old syndicate and creating an Antimony Administration under the National Resources Commission. According to some sources, this move was prompted primarily by a desire to divert to the National Government the taxes collected by the Provincial Government.

The new administration immediately established production and export quotas, and during the first quarter of 1936 dealers found it difficult to obtain enough export permits to meet the growing demands of world trade. This difficulty was remedied during the second quarter of the year. During the third quarter speculators became active in the local markets. It was reported that 3,000 of the 4,400 long tons of antimony on hand in China were owned by speculators intent on raising local prices. Daily transactions on the Changsha market, mostly between local dealers, often totaled 500 to 700 tons, whereas the daily production of metal was less than 50 tons. The speculative market thus created was opposed by the National Antimony Administration, and at the close of the year drastic measures were taken to reduce prices and bring some degree of stability to the market. It was reported that, effective January 1, 1937, permits to ship antimony from Hunan Province would be issued only to the Antimony Administration. Prices were established for the purchase and sale of antimony. On January 1, 1937, the price for regulus payable to miners and smelters was set at Ch $450 per ton, c. i. f. Changsha, which was considerably below the Ch $800 currently quoted on the Hankow market. The announced selling price on the same date at

Changsha was Ch $618. An office was set up at Hankow to receive and execute orders from local exporting firms and concerns abroad wishing to purchase antimony. It is expected that the office will deal directly with buyers in foreign countries, and to this end a commission is to be sent abroad to encourage direct transactions.

The foregoing actions of the Administration met with considerable opposition from dealers and producers. It was evident that the policy of the administration was to eliminate the Changsha dealers from the trade entirely. The producers felt that in offering such low prices the administration was absorbing profits that should accrue to them. It was reported that as a defense measure producers had agreed to make no sales to the administration and to curtail production sharply so that the administration would be unable to obtain supplies to sell to local exporters. The administration countered with a threat to take over the mines if the measures adopted by the producers proved to be effective. While details as to the outcome of the controversy are not available at this time, the decline in estimated production in Hunan from 1,200 long tons in December 1936 to 650 tons in January 1937 and a subsequent rise to 1,100 tons in April suggests that the producers may have carried out their program partly. This is indicated further by the large increase in stocks of metal at the mines and the virtual depletion of supplies at Changsha and Hankow during the first 3 months of 1937 and the cessation of shipments from Changsha in April.

According to United States Vice Consul Arthur R. Ringwalt, of Yunnanfu, the rise in the price of antimony during the last 2 years has stimulated interest in the antimony deposits of Yunan Province. The richest deposits are found in the neighborhood of Chihtsum on the Yunnan Railway near Mengtsz and Lusi 80 miles to the north of Chihtsum. Other deposits occur near Yenshan 50 miles east of Chihtsum. A small amount was produced in 1936. Operations appear to have been halted by the establishment of a Government monopoly to control production of tungsten ores as well as antimony. It is believed that the Province will be a marginal producer at best.

Colombia.—Late in the year it was reported that an antimony mine was being developed in the State of Tolima.

Japan.—The Japanese Antimony Mining Co. is planning a new refinery at Amagasaki, Hyogo Province.

Mexico.—The production of antimony in Mexico has increased considerably during the last few years, owing largely to the greater requirements of the antimony smelter at Laredo, Tex. The principal mines are situated in the Catorce district, San Luis Potosi, and some ore is produced in the Atlas district, Sonora. Metallic antimony is produced in Mexico as a byproduct of lead ores at the Monterrey smelter of the Compania Minera de Penoles, S. A.

U. S. S. R. (Russia.).—A trial plant for the production of 70 metric tons of metallic antimony annually was reported under construction at Kadamzhai, South Kazakstan. At Turgai, North Kazakstan, a smelter has been producing antimony trisulphide since the end of 1935, and by the end of 1936 a second plant will be producing metallic antimony and antimony pentoxide.

Yugoslavia.—The Podrinje Consolidated Mines, Ltd., under British management, has resumed operations at its antimony, lead, and silver mines at Krupanj and Stolici. In the latter mines the ore is said to contain 25 to 30 percent antimony. A new plant with a

daily capacity of 4 tons of antimony (99.6 percent pure) has been completed.

CADMIUM

Production and consumption of cadmium in the United States established new peaks in 1936. Consumption throughout most of the year was so heavy that domestic producers, with stocks depleted by the record sales of 1935, were unable to meet the demand. Consequently, there was a large increase in imports. Prices broke sharply about the middle of the year, but the average for 1936, 97.8 cents per pound, was considerably above the 70.5 cents recorded for 1935. Average values realized by producers on sales of metal, however, were below quoted averages. Partial returns received by the Bureau of Mines indicated average selling prices of about 80 cents in 1936 and 50 cents in 1935. At the close of the year producers' stocks were exhausted.

High prices and scarcity of supplies have retarded development of new uses and forced substitution in some of the old ones. Bright zinc coatings have replaced cadmium plating in many instances, and other materials have been substituted for cadmium pigments to some extent. The concern that pioneered in the use of cadmium alloys in automobile bearings reverted to tin-base alloys in 1936. Although other manufacturers have adopted cadmium bearings, the threatened loss of this market precipitated the price drop mentioned previously.

In Europe production exceeded demand during the first 9 months and prices at London declined from $1.21 in February to 57 cents in September. In the last quarter sales increased rapidly, so that by the close of the year stocks were exhausted and the price had risen to 98 cents. World production increased 17 percent in 1936.

Cadmium produced, sold by producers, imported, and consumed in the United States, 1929–36, in pounds

Year	Produced			Metallic cadmium sold by producers	Metallic cadmium imported	Domestic consumption
	Metallic cadmium	Cadmium compounds (estimated content)	Total cadmium			
1929	2,481,427	433,300	2,915,000	2,330,617	214,307	3,129,000
1930	2,777,762	316,300	3,094,000	1,664,644	40,105	3,134,000
1931	1,050,529	337,200	1,388,000	1,544,414	271	1,388,000
1932	799,501	259,800	1,059,000	1,154,151		1,059,000
1933	2,276,933	401,400	2,678,000	2,447,014	108,861	2,787,000
1934	2,777,384	566,700	3,344,000	2,472,971	125,955	3,470,000
1935	3,477,091	507,400	3,984,000	4,023,900	185,387	4,169,000
1936	3,633,495	626,800	4,260,000	3,626,669	576,139	4,836,000

DOMESTIC PRODUCTION

The following firms reported the production of cadmium and cadmium compounds in 1936:

Producers of cadmium or cadmium compounds in the United States in 1936

	Location of plant
American Smelting & Refining Co	Denver, Colo.
American Zinc Co. of Illinois	Fairmont City, Ill.
Anaconda Copper Mining Co	Great Falls, Mont.
Ceramic Color & Chemical Manufacturing Co	New Brighton, Pa.
Chemical & Pigment Co	Baltimore, Md.
E. I. du Pont de Nemours & Co	Cleveland, Ohio.
Harshaw Chemical Co	Elyria, Ohio.
New Jersey Zinc Co	Palmerton, Pa.
Sherwin-Williams Co	Chicago, Ill.
St. Joseph Lead Co	Herculaneum, Mo.
Sullivan Mining Co	Kellogg, Idaho.
United Color & Pigment Co	Newark, N. J.
U. S. Smelting, Refining and Mining Co	Midvale, Utah.

Domestic production of primary cadmium is derived from the treatment of flue dust from copper and lead smelters, as a byproduct from the smelting and electrolytic reduction of zinc ores, and from the purification of zinc sulphate solutions used in the manufacture of lithopone. Thus, further expansion of cadmium production depends largely on increases in the output of copper, lead, and particularly zinc.

Of interest as a potential means of obtaining an additional source of supply is the Queneau process for removing cadmium and other metals from zinc concentrates. A cheap chloride is added to the roasted concentrate, and the mixture is subjected to a blast roast that volatilizes as chlorides the cadmium and other contaminating metals. The fume is collected and treated further for the recovery of the various metals. The process, which is described in United States Patent 1999209, April 30, 1935, is said to present a method of recovering much of the cadmium that now goes into prime western grades of zinc. A similar process, in which fluorides are used instead of chlorides, also has been proposed for the recovery of cadmium from zinc ores (United States Patent 2064835, December 22, 1936).

A small quantity of secondary cadmium is recovered from the scrap from the manufacture of automobile bearings. This is not included in the statement of production, as it would represent duplication of metal previously reported.

DOMESTIC CONSUMPTION

Cadmium is used principally in the manufacture of alloys and compounds and as a plating material. Prior to 1935 the latter use was the most important, but in that year the adoption of cadmium alloys for bearing metals by some automobile manufacturers raised this use of the metal to first place. The resulting shortage of supply and rise in price forced the substitution of zinc in plating in many cases.

According to some authorities, the superiority of cadmium over zinc in platings has been exaggerated. Diggin[3] suggests that the bright coatings obtained with cadmium proved to be more salable than the dull finishes formerly obtained with zinc. This advantage,

[3] Diggin, M. B., Recent Developments Open Path to Wider Use of Bright Zinc Plating: Steel, vol. 98, no. 16, Apr. 20, 1936, p. 44.

however, has disappeared since the development of bright zinc coatings. Cadmium coatings formerly were applied more easily, but this advantage likewise has been eliminated to some extent by improvements in zinc-plating technique.

Soderberg,[4] on the other hand, states that the substitution of zinc in plating was due to the increased consumption of cadmium in other industries, and that the advantages of cadmium plating will again lead to its greater employment for various purposes. He points out that the brightness of cadmium plating is more permanent than that of bright zinc coatings. Cadmium withstands corrosion better than zinc under certain conditions, such as in alkaline solutions. The low electrical contact resistance between cadmium-plated surfaces and the ease with which they can be soldered are factors that favor the use of cadmium. He also claims that cadmium plating can be done more easily than zinc plating.

Corrosion tests on cadmium and zinc coatings on steel conducted by the Bureau of Standards [5] indicated no significant difference in the two metals in mild or marine atmospheres. In industrial areas where the air was contaminated with sulphur compounds zinc was superior to cadmium. A coating consisting of about 10 percent cadmium and 90 percent zinc was found to be superior to either zinc or cadmium.

R. J. McKay and R. Worthington have presented a summary and bibliography of cadmium plating in chapter 8 of Mimeograph Series 71, entitled "Corrosion Resistance of Metals and Alloys", published in 1936 by the American Chemical Society.

The future of cadmium alloys in automobile bearings seems to depend upon the ability of producers to furnish adequate supplies of the metal at prices below those prevailing in recent years. According to some reports, several firms have deferred adopting cadmium alloy because the supply is uncertain, and some companies recently discontinued using cadmium bearings. The problem of producing lubricants that will not corrode cadmium alloys apparently has been solved. Ordinary tin-base bearing metals can be strengthened considerably by adding 1 percent of cadmium.

The development of cadmium-zinc solders for aluminum and sheet steel was reported in 1936.

The use of cadmium in compounds increased in 1936. Production of cadmium lithopone, which was curtailed sharply in 1935 because of shortage of supplies, increased materially, and the manufacture of sulphides increased substantially, also.

FOREIGN TRADE

Official statistics record only the imports of metallic cadmium. There is some import and export trade in cadmium compounds and some metal is known to have been exported in former years, but the quantities involved are believed to be relatively unimportant. Imports of metallic cadmium increased 211 percent in 1936. Of the 576,139 pounds received, Canada supplied 238,599, Belgium 170,656, United Kingdom 108,866, Norway 33,619, Germany 11,519, Australia 10,640, and Netherlands 2,240. The United States also imports crude

[4] Soderberg, Gustav., The Future of Cadmium Plating: The Metal Industry, London, vol. 49, no. 22, Nov. 27, 1936, pp. 543-545.

[5] Blum, William, Strausser, Paul, W. C., and Brenner, Abner, Corrosion-Protective Value of Electrodeposited Zinc and Cadmium Coatings on Steel: Jour. Research, National Bureau of Standards, vol. 16, no. 2, February 1936, pp. 185-212.

materials containing cadmium for refining. In 10 months of 1936, Mexico reported exports of approximately 500 tons of cadmium to the United States.

PRICES

According to Engineering and Mining Journal, the average price of cadmium in 1936 was 97.8 cents per pound, compared with 70.5 cents in 1935 and 55 cents from 1931 to 1934. In 1929 the price ranged from 80 to 95 cents per pound. Incomplete data obtained from producers by the Bureau of Mines indicate that the average value realized on sales of metallic cadmium in 1935 was about 50 cents per pound and in 1936, 80 cents.

The quoted price of cadmium was maintained at $1.025 to $1.05 per pound for the first 5 months of 1936. During this period it was rumored that some automobile manufacturers using cadmium bearing metals were threatening to revert to the use of tin-base metal on account of the high price of cadmium and constant shortage of supplies. About the middle of June, in an effort to prevent this move, producers reduced the price to bearing makers to 75 cents for large-scale transactions. The price to platers remained the same. On July 16, E. and M. J. Metal and Mineral Markets began to quote small parcels, spot, at $1.05 and quantity business for nearby and forward delivery at 75 cents to $1. These quotations held for the balance of the year, although on July 30 the designations were changed to "spot lots to platers, patented shapes, $1.05" and "quantity business, commercial sticks, prompt and forward shipment, 75 cents to $1".

On the London market the demand for cadmium continued good, but additional supplies that came into the market from new producers sent prices down from a high of 4 s. 10 d. ($1.21 per pound) in February to a low of 2 s. 3 d. ($0.57) in September. The low price stimulated consumption and diverted some foreign supplies from the European market. Supplies again became scarce, and as a consequence prices moved up. At the close of the year the quotation stood at 4 s. ($0.98).

WORLD PRODUCTION

World production of cadmium in 1936 is estimated at 3,665 metric tons, 17 percent more than in 1935. The United States contributed 53 percent of this total, but some of it was derived from cadmium materials imported from Mexico. All the countries for which 1936 data are available, except Norway and South-West Africa, made substantial increases in production. South-West Africa ships cadmium-bearing flue dusts to Germany for treatment, but German production statistics apparently do not include the cadmium derived therefrom.

World production of cadmium, 1929 and 1932–36, by countries, in kilograms

[Compiled by R. B. Miller]

Country	1929	1932	1933	1934	1935	1936
Australia (Tasmania)	202,261	160,852	162,074	172,588	222,108	251,826
Belgium	[1] 2,313	124,488	161,024	225,999	151,001	293,500
Canada	351,068	29,676	111,602	133,179	250,018	356,484
France	59,000	49,000	40,000		120,997	(2)
Germany	41,000	[3] 40,000	[3] 40,000	[3] 40,000	165,000	303,000
Italy	(2)	6,238	6,934	8,345	16,012	(2)
Japan		4,539	3,047	28,830	3,236	(2)
Mexico	(4)	(4)	(4)	(4)	(4)	(4)
Norway	(2)	109,000	139,734	137,324	118,335	108,197
Poland	3,584	34,602	53,083	143,557	120,700	140,900
South-West Africa	(2)			63,503	145,149	109,200
U. S. S. R. (Russia)	(2)			2,585	12,000	(2)
United Kingdom [1]	2,357	1,683	15,922	6,073	(2)	(2)
United States:						
Cadmium compounds [5]	196,541	117,843	182,071	257,049	230,152	284,310
Metallic cadmium	1,125,550	362,646	1,032,794	1,259,794	1,577,174	1,648,117
	1,980,000	1,040,000	1,950,000	2,480,000	3,140,000	3,665,000

[1] Exports of domestic product. Production figures not available.
[2] Data not available. Estimate included in total.
[3] Estimated production.
[4] The Mexican Government reports the total cadmium content of material produced in Mexico as follows: 1929, 640,968 kilos; 1932, 86,174 kilos; 1933, 502,160 kilos; 1934, 334,714 kilos; 1935, 597,527 kilos; and 1936, 537,017 kilos. This material is exported for extraction elsewhere; therefore, to avoid duplication of figures, the data are not included in this table.
[5] Estimated cadmium content.

REVIEW BY COUNTRIES

Australia.—Cadmium is recovered as a byproduct from zinc ores treated at the electrolytic zinc plant at Risdon, Tasmania. Greater production in 1936 reflects the larger output of zinc in that year.

Belgium.—The principal producer is Vieille Montagne. In 1936 Compagnie Overpelt Lommel et Corphalie began production of high-grade metal at its Campine plant.

Canada.—The cadmium plant of the Hudson Bay Mining & Smelting Co., Ltd., was put into operation during 1936, thus increasing the supply of metal from this country. Formerly the Trail plant of the Consolidated Mining & Smelting Co. of Canada, Ltd., was the only producer.

Germany.—Increased supply from the new Magdeburg plant has stimulated the substitution of cadmium for tin in solders and bearing metals as Germany relies largely on imports for her tin. The Magdeburg plant has an annual capacity of 150 to 180 tons of cadmium and operates on residues obtained from the treatment of Upper Silesian zinc-blende concentrates, which contain approximately 0.25 percent cadmium.

Mexico.—Considerable cadmium is recovered from flue dusts collected at Mexican smelters and exported to other countries for treatment. For 1936, production is estimated at 535 metric tons of metal. Exports were approximately 500 tons, all of which went to the United States.

South-West Africa.—320 tons of smelter-flue dust containing 30.46 percent cadmium were shipped to Germany from stocks at the Tsumeb mine. The sharp decline in shipments in 1936 suggests that this source of supply is approaching depletion.

U. S. S. R. (Russia).—Cadmium is produced at the Ridder, Orzhonikidzi, and Cheliabinsk plants; the last was completed only recently.

United Kingdom.—Imperial Smelting Corporation, Ltd., completed a new plant for the production of cadmium during 1936; full-scale operation was expected early in 1937.

PLATINUM AND ALLIED METALS [1]

By H. W. Davis

SUMMARY OUTLINE

Although platinum occurs over a wide area in Alaska, California, and Oregon (the chief producing localities of this country), the proportion of the platinum metals present usually is small, and the deposits could not be worked profitably if it were not for the gold content. The quantity of platinum metals recovered annually from these placer deposits averaged about 1,200 ounces during the decade 1926–35 and was an almost negligible part of the world supply. Considerable quantities—775 ounces in 1924, 2,842 ounces in 1925, 3,330 ounces in 1926, and 108 ounces in 1927—of palladium formerly were recovered from domestic palladium-bearing copper ore, but none has been recovered since 1927. Much larger quantities of platinum metals are obtained in the United States as byproducts of gold and other metals (about 6,100 ounces annually during the 10 years 1926–35), but the total output from domestic sources has slight importance compared with domestic consumption. However, in 1934 and 1935 larger quantities of platinum metals were recovered from domestic placer deposits (2,416 ounces and 6,748 ounces, respectively) than were obtained as byproducts of gold and other metals (2,335 ounces in 1934 and 2,483 ounces in 1935). The United States, nevertheless, is an important contributor to the world supply of refined new metals, as it has furnished about 47,600 ounces annually for 1926–35. The bulk of the output comes from crude platinum imported from foreign sources, notably Colombia. In addition, this country has supplied about 46,600 ounces of secondary platinum metals annually from 1926 to 1935.

It is estimated that the world's known workable deposits of platinum can supply annually about 400,000 ounces of new platinum and about 70,000 ounces of palladium. Canada can furnish about 125,000 ounces of platinum; Colombia, 50,000 ounces; U. S. S. R. (Russia),

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

150,000 ounces; Union of South Africa, 50,000 ounces; and the rest of the world, about 25,000 ounces. Canada also can produce about 60,000 ounces of palladium annually and the remainder of the world about 10,000 ounces.

Salient statistics of platinum and allied metals in the United States, 1935–36, in troy

	1935	1936		1935	1936
Production:			Stocks in hands of refiners, Dec. 31:		
Crude platinum from placers	9,069	9,785	Platinum	50,265	56,886
New metals:			Palladium	27,807	29,853
Platinum	[1] 37,284	[1] 39,728	Other	15,475	17,178
Palladium	1,432	4,682		93,547	103,917
Other	3,344	2,536	Imports for consumption:		
	42,060	46,946	Platinum	122,550	157,346
Secondary metals:			Palladium	26,579	38,842
Platinum	47,107	55,959	Other	15,020	14,252
Palladium	7,852	6,786		164,149	210,440
Other	4,166	3,421	Exports:		
	59,125	66,166	Unmanufactured	[2] 3,271	55,454
			Manufactures (except jewelry)	[2] 1,954	2,590

[1] In 1935 includes 6,593 ounces of new platinum from domestic sources, comprising 5,232 ounces derived from crude placer platinum and 1,361 ounces obtained from domestic gold and copper ores as a byproduct of refining; in 1936 includes 7,355 ounces of new platinum from domestic sources, comprising 2,880 ounces derived from crude placer platinum, 32 ounces recovered from ore, and 4,443 ounces obtained from domestic gold and copper ores as a byproduct of refining.

[2] Exclusive of exports by parcel post.

CRUDE PLATINUM

Production.—Mine returns for 1936 indicate a production of 8,825 troy ounces of crude platinum in Alaska, 900 ounces in California, and 60 ounces in Oregon—a total of 9,785 ounces (9,069 ounces in 1935). The greater part of the production in Alaska came from placers in the Goodnews Bay district south of the mouth of the Kuskokwim River, but small quantities were recovered in placer-gold mining in the Koyuk district, Seward Peninsula, and in reworking the tailings from earlier lode-mining operations in the Ketchikan district, Kasaan Peninsula. In California most of the platinum produced was a byproduct of dredges working the gold placers in Merced, Sacramento, Stanislaus, and Yuba Counties. Production in Oregon came mainly from the ocean beach near Cape Blanco in Curry County.

Many gold and copper ores in the United States contain comparatively small quantities of platinum. These ores usually furnish the greater part of the new platinum recovered annually from domestic sources. In 1934 and 1935, however, much the greater part of the new platinum recovered from domestic sources was placer platinum. For example, 1,914 and 5,232 ounces, respectively, of platinum were recovered from placers in 1934 and 1935 and 1,062 and 1,361 ounces, respectively, as a byproduct of refining gold and copper ores in 1934 and 1935.

Purchases.—Platinum refiners in the United States reported purchases of domestic crude platinum from the following sources in 1936: Alaska, 3,174 ounces; California, 926 ounces; Oregon, 80 ounces; and unspecified, 21 ounces—a total of 4,201 ounces (7,730 ounces in 1935).

Refiners in the United States also reported purchases of 42,042 ounces (44,642 ounces in 1935) of foreign crude platinum in 1936—4 ounces from Canada, 37,949 ounces from Colombia, 1,312 ounces from Ethiopia, and 2,777 ounces from South Africa.

Markets and prices.—Returns received from the sale of crude platinum are disappointing to miners who are unaware that quotations usually refer not to the price of the metallic content of crude platinum but to that of the pure metals that have been subjected to treatment costs.

Sellers of domestic crude platinum reported that they were paid for metal content based on assay. Buyers reported purchases at $18 to $46.54 an ounce for domestic and $23.28 to $39.87 an ounce for foreign crude platinum. A list of refiners in the United States who purchased foreign and domestic crude platinum in 1936 follows:

American Platinum Works, 225 New Jersey Railroad Avenue, Newark, N. J.
Baker & Co., Inc., 54 Austin Street, Newark, N. J.
Sigmund Cohn, 44 Gold Street, New York, N. Y.
Goldsmith Bros. Smelting & Refining Co., 1300 West Fifty-ninth Street, Chicago, Ill.
S. B. Gracier & Sons, 212 Stockton Street, San Francisco, Calif.
Kastenhuber & Lehrfeld, 24 John Street, New York, N. Y.
Pacific Platinum Works, Inc., 814 South Spring Street, Los Angeles, Calif.
Western Gold & Platinum Works, 589 Bryant Street, San Francisco, Calif.
Wildberg Bros. Smelting & Refining Co., 742 Market Street, San Francisco, Calif.

REFINED PLATINUM METALS

New metals recovered.—Reports from refiners of crude platinum, gold bullion, and copper indicate that 46,946 ounces of platinum metals were recovered in the United States from these sources in 1936, an increase of 12 percent compared with 1935. It is estimated that 12,720 ounces of the total in 1936 were derived from domestic sources.

New platinum metals recovered by refiners in the United States, 1935–36, by sources, in troy ounces

	Platinum	Palladium	Iridium	Osmiridium	Others	Total
1935						
Domestic:						
Crude platinum	5,232	27	1,073	40	376	6,748
Gold and copper refining	1,361	1,115	4		3	2,483
	6,593	1,142	1,077	40	379	9,231
Foreign: Crude platinum	30,691	290	1,361	409	78	32,829
Total recovery	37,284	1,432	2,438	449	457	42,060
1936						
Domestic:						
Crude platinum	2,880	18	392	101	235	3,626
Ore	32				78	110
Gold and copper refining	4,443	4,505	35		1	8,984
	7,355	4,523	427	101	314	12,720
Foreign: Crude platinum	32,373	159	1,251	440	3	34,226
Total recovery	39,728	4,682	1,678	541	317	46,946

150,000 ounces; Union of South Africa, 50,000 ounces; and the rest of the world, about 25,000 ounces. Canada also can produce about 60,000 ounces of palladium annually and the remainder of the world about 10,000 ounces.

Salient statistics of platinum and allied metals in the United States, 1935–36, in troy ounces

	1935	1936
Production:		
Crude platinum from placers	9,069	9,785
New metals:		
Platinum	[1] 37,284	[1] 39,728
Palladium	1,432	4,682
Other	3,344	2,536
	42,060	46,946
Secondary metals:		
Platinum	47,107	55,959
Palladium	7,852	6,786
Other	4,166	3,421
	59,125	66,166

	1935	1936
Stocks in hands of refiners, Dec. 31:		
Platinum	50,265	56,886
Palladium	27,807	29,853
Other	15,475	17,178
	93,547	103,917
Imports for consumption:		
Platinum	122,550	157,346
Palladium	26,579	38,842
Other	15,020	14,252
	164,149	210,440
Exports:		
Unmanufactured	[2] 3,271	55,454
Manufactures (except jewelry)	[2] 1,954	2,590

[1] In 1935 includes 6,593 ounces of new platinum from domestic sources, comprising 5,232 ounces derived from crude placer platinum and 1,361 ounces obtained from domestic gold and copper ores as a byproduct of refining; in 1936 includes 7,355 ounces of new platinum from domestic sources, comprising 2,880 ounces derived from crude placer platinum, 32 ounces recovered from ore, and 4,443 ounces obtained from domestic gold and copper ores as a byproduct of refining.

[2] Exclusive of exports by parcel post.

CRUDE PLATINUM

Production.—Mine returns for 1936 indicate a production of 8,825 troy ounces of crude platinum in Alaska, 900 ounces in California, and 60 ounces in Oregon—a total of 9,785 ounces (9,069 ounces in 1935). The greater part of the production in Alaska came from placers in the Goodnews Bay district south of the mouth of the Kuskokwim River, but small quantities were recovered in placer-gold mining in the Koyuk district, Seward Peninsula, and in reworking the tailings from earlier lode-mining operations in the Ketchikan district, Kasaan Peninsula. In California most of the platinum produced was a byproduct of dredges working the gold placers in Merced, Sacramento, Stanislaus, and Yuba Counties. Production in Oregon came mainly from the ocean beach near Cape Blanco in Curry County.

Many gold and copper ores in the United States contain comparatively small quantities of platinum. These ores usually furnish the greater part of the new platinum recovered annually from domestic sources. In 1934 and 1935, however, much the greater part of the new platinum recovered from domestic sources was placer platinum. For example, 1,914 and 5,232 ounces, respectively, of platinum were recovered from placers in 1934 and 1935 and 1,062 and 1,361 ounces, respectively, as a byproduct of refining gold and copper ores in 1934 and 1935.

Purchases.—Platinum refiners in the United States reported purchases of domestic crude platinum from the following sources in 1936: Alaska, 3,174 ounces; California, 926 ounces; Oregon, 80 ounces; and unspecified, 21 ounces—a total of 4,201 ounces (7,730 ounces in 1935).

Refiners in the United States also reported purchases of 42,042 ounces (44,642 ounces in 1935) of foreign crude platinum in 1936—4 ounces from Canada, 37,949 ounces from Colombia, 1,312 ounces from Ethiopia, and 2,777 ounces from South Africa.

Markets and prices.—Returns received from the sale of crude platinum are disappointing to miners who are unaware that quotations usually refer not to the price of the metallic content of crude platinum but to that of the pure metals that have been subjected to treatment costs.

Sellers of domestic crude platinum reported that they were paid for metal content based on assay. Buyers reported purchases at $18 to $46.54 an ounce for domestic and $23.28 to $39.87 an ounce for foreign crude platinum. A list of refiners in the United States who purchased foreign and domestic crude platinum in 1936 follows:

American Platinum Works, 225 New Jersey Railroad Avenue, Newark, N. J.
Baker & Co., Inc., 54 Austin Street, Newark, N. J.
Sigmund Cohn, 44 Gold Street, New York, N. Y.
Goldsmith Bros. Smelting & Refining Co., 1300 West Fifty-ninth Street, Chicago, Ill.
S. B. Gracier & Sons, 212 Stockton Street, San Francisco, Calif.
Kastenhuber & Lehrfeld, 24 John Street, New York, N. Y.
Pacific Platinum Works, Inc., 814 South Spring Street, Los Angeles, Calif.
Western Gold & Platinum Works, 589 Bryant Street, San Francisco, Calif.
Wildberg Bros. Smelting & Refining Co., 742 Market Street, San Francisco, Calif.

REFINED PLATINUM METALS

New metals recovered.—Reports from refiners of crude platinum, gold bullion, and copper indicate that 46,946 ounces of platinum metals were recovered in the United States from these sources in 1936, an increase of 12 percent compared with 1935. It is estimated that 12,720 ounces of the total in 1936 were derived from domestic sources.

New platinum metals recovered by refiners in the United States, 1935–36, by sources, in troy ounces

	Platinum	Palladium	Iridium	Osmiridium	Others	Total
1935						
Domestic:						
Crude platinum	5,232	27	1,073	40	376	6,748
Gold and copper refining	1,361	1,115	4		3	2,483
	6,593	1,142	1,077	40	379	9,231
Foreign: Crude platinum	30,691	290	1,361	409	78	32,829
Total recovery	37,284	1,432	2,438	449	457	42,060
1936						
Domestic:						
Crude platinum	2,880	18	392	101	235	3,626
Ore	32				78	110
Gold and copper refining	4,443	4,505	35		1	8,984
	7,355	4,523	427	101	314	12,720
Foreign: Crude platinum	32,373	159	1,251	440	3	34,226
Total recovery	39,728	4,682	1,678	541	317	46,946

New platinum metals recovered by refiners in the United States, 1932–36, in troy ounces

Year	Platinum	Palladium	Iridium	Osmiridium	Others	Total
1932	14,666	1,252	1,362	328	8	17,616
1933	48,581	942	1,434	492	90	51,539
1934	43,392	1,471	1,588	585	238	47,274
1935	37,284	1,432	2,438	449	457	42,060
1936	39,728	4,682	1,678	541	317	46,946

Secondary metals recovered.—Secondary platinum metals are those recovered from the treatment of scrap metal, sweeps, and other waste products of manufacture that contain platinum. In 1936, 66,166 ounces of secondary platinum metals were recovered, an increase of 12 percent over 1935 and the largest quantity recovered since 1917.

Secondary platinum metals recovered in the United States, 1932–36, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1932	21,635	5,783	3,726	1,444	32,588
1933	35,073	4,814	692	783	41,362
1934	35,494	5,606	1,328	1,328	43,756
1935	47,107	7,852	2,191	1,975	59,125
1936	55,959	6,786	2,204	1,217	66,166

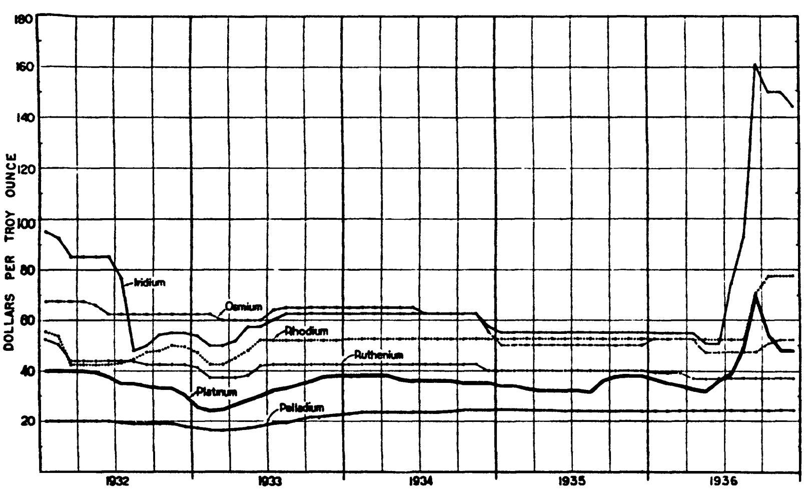


FIGURE 43.—Average monthly prices per troy ounce of platinum and allied metals at New York, 1932–36.

Prices.—Refiners reported the following prices for platinum in 1936: High $70, low $26.81, and average for the year $41.76 an ounce, compared with $40, $25.66, and $32.60 an ounce, respectively, for 1935. They gave the following prices for palladium: High $26, low $18, and average for the year $23.03 an ounce, compared with $26, $18, and $23.25 an ounce, respectively, for 1935.

Refined platinum in 3-ounce bars was made available for speculative and investment buying in 1936. Chiefly because of such speculative flurry and improvement in world demand, the price of platinum

advanced from $33 an ounce in April to $70 an ounce in September, but toward the end of the year it dropped to $48 an ounce. The price of iridium rose from $55 to $175 an ounce during the period of heavy demand.

Figure 43 shows the average monthly official prices quoted for platinum metals from 1932 to 1936.

Consumption.—The next table shows sales of platinum metals to consumers by refiners in the United States in 1935 and 1936. The figures include sales (by refiners in the United States) of platinum metals recovered from crude platinum, from gold bullion, from copper and nickel bullion and matte, from electrolytic muds, and from scrap materials and sweeps; in addition, they include sales of considerable quantities of imported platinum metals that are handled by refiners in the United States. Sales of platinum metals by refiners in the United States increased from 125,064 ounces in 1935 to 164,847 in 1936.

The uses of the platinum group are many and varied. The most widely used metal of the group is platinum itself, which constituted 112,447 ounces (68.2 percent) of the total platinum metals sold by domestic refiners in 1936. The largest user of platinum is the jewelry industry, where it is favored for engagement and wedding rings and finer settings. It is also used in collar pins, cuff links, pencils, and knives. Platinum-clad nickel is used for dresser sets, after-dinner coffee services, trophies, medals, and watchcases. Sales of platinum by domestic refiners to the jewelry industry were 50,936 ounces in 1936 (56,182 ounces in 1935). The second largest consumer of platinum in 1936 was the chemical industry, which used the metal chiefly as a catalyzer in the manufacture of sulphuric, acetic, and nitric acids; as a still for sulphuric acid; as an anode for electrochemical processes; and as chemical ware in the form of crucibles, dishes, and other laboratory equipment. The dental industry, in which platinum is used chiefly in posts and pins for artificial teeth, ranked third as a consumer in 1936. The electrical industry was the fourth largest consumer of platinum in 1936; the metal was used chiefly in contact points, telephone and telegraph apparatus, and magneto contacts.

Next to platinum, palladium is the most extensively used metal of the platinum group; it constituted 45,539 ounces (27.6 percent) of the total platinum metals sold by domestic refiners in 1936. It is by far the cheapest metal of the platinum group, especially volume for volume, and tends more and more to replace other metals. The largest consumer of palladium in 1936 was the dental industry, which purchased 25,481 ounces from domestic refiners compared with 20,916 ounces in 1935, 19,555 ounces in 1934, and average annual purchases of about 13,200 ounces during the 5-year period 1929–33. Palladium and platinum are standard materials in the preparation of dental alloys, as they are strong and impervious to attack by the acids in the mouth and can readily be cast and shaped to the complex forms required. The fact that dental alloys of high palladium content are less conspicuous than gold, are nontarnishable, and are economical, especially when palladium replaces a considerable quantity of gold, has led to an increase in the demand for palladium in dentistry. The electrical and jewelry industries are the next largest users of palladium, and small quantities are used in the manufacture of chemical ware and for miscellaneous purposes. Appreciation by the public of the fact that palladium has the same handsome color as its better-known

related metal, platinum, and is highly resistant to corrosion and tarnish as well, has resulted in greater use of the metal in jewelry. The gain (from 5,490 ounces in 1935 to 13,297 ounces in 1936) in sales of palladium to the electrical industry is noteworthy. Palladium leaf, first introduced in 1933, is being more widely accepted in diverse fields. Like gold, palladium can be beaten successfully into leaf for use for decorative effects on shoes, hats, gloves, pocketbooks, picture frames, and display signs. Novel applications recently have been as trim for lighting fixtures, for striping and lettering trains, and as a surface for the ceiling of a room in a Federal structure. Some palladium-clad molybdenum has been produced for special purposes.

The uses of iridium are few compared with those of platinum and palladium, but it ranks third among the platinum group as to consumption. Of the total sales of platinum metals in 1936, 4,390 ounces (2.7 percent) were iridium. It is employed chiefly as a hardener for platinum, principally in the manufacture of jewelry, in which a 10-percent iridium alloy is used, and in the electrical industry, in which an alloy containing 15 percent or more iridum is used. Some iridium is used in making fountain-pen points.

The consumption of the other platinum metals—osmium, rhodium, and ruthenium—is very small, amounting to only 1.5 percent of the total consumption of the group in 1936. Because of its brilliance and durability, rhodium has been called "the diamond of the metals." As rhodium is one of the whitest and hardest of all metals and never tarnishes, rhodium plating is being used more and more as a finish for jewelry and silverware and for surfacing reflectors in searchlights.

Platinum metals sold by refiners in the United States, 1935–36, by consuming industries, in troy ounces

Industry	Platinum	Palladium	Iridium	Others	Total	Percentage of total
1935						
Chemical	13,404	69	102	1	13,576	11
Electrical	5,867	5,490	662	276	12,295	10
Dental	9,694	20,916	130	43	30,783	25
Jewelry	56,182	5,095	3,508	579	65,364	52
Miscellaneous	2,505	200	95	246	3,046	2
	87,652	31,770	4,497	1,145	125,064	100
1936						
Chemical	20,984	124	131	256	21,495	13
Electrical	8,750	13,297	894	367	23,308	14
Dental	15,489	25,481	148	26	41,144	25
Jewelry	50,936	5,778	3,100	1,066	60,880	37
Miscellaneous and undistributed	16,288	859	117	756	18,020	11
	112,447	45,539	4,390	2,471	164,847	100

Stocks.—On December 31, 1936, 103,917 ounces of platinum metals were in the hands of refiners compared with 93,547 ounces in 1935.

Stocks of platinum metals in the hands of refiners in the United States, Dec. 31, 1932–36, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1932	37,976	19,707	10,307	7,921	75,911
1933	41,204	20,581	7,622	7,615	77,022
1934	41,370	26,377	8,269	7,905	83,921
1935	50,265	27,807	9,202	6,273	93,547
1936	56,886	29,853	8,943	8,235	103,917

FOREIGN TRADE

Imports.—The following tables show imports into the United States of platinum metals, which increased from 164,149 ounces in 1935 to 210,440 in 1936. Chief sources of imported platinum metals in 1936 were the United Kingdom (172,367 ounces) and Colombia (29,119 ounces). Imports of crude platinum from Colombia increased from 25,440 ounces in 1935 to 29,119 in 1936. Imports of palladium (chiefly from the United Kingdom) increased from 26,579 ounces in 1935 to 38,842 in 1936. Imports of platinum metals from the U. S. S. R. (Russia) decreased from 25,033 ounces in 1935 to 4,750 in 1936.

Platinum metals imported for consumption in the United States, 1935–36, by metals

Metal	1935		1936	
	Troy ounces	Value	Troy ounces	Value
Platinum:				
Ores of platinum metals (platinum content)	688	$13,716	2,204	$71,781
Grain, nuggets, sponge, or scrap	61,159	1,480,450	103,121	2,931,596
Ingots, bars, sheets, or plates not less than ⅛-inch thick	60,703	1,849,114	52,013	1,880,702
	122,550	3,343,280	157,338	4,884,079
Manufactures of, not jewelry			8	730
Iridium	5,456	245,146	2,668	213,340
Osmiridium	4,589	115,326	4,300	108,803
Osmium	110	3,216	1,747	53,308
Palladium	26,579	400,098	38,842	590,189
Rhodium	3,990	96,882	4,945	129,796
Ruthenium	875	24,074	592	15,789
	164,149	4,228,022	210,440	5,996,034

Platinum metals (unmanufactured) imported for consumption in the United States in 1936, by countries, in troy ounces

Country	Platinum			Iridium	Osmium and osmiridium	Palladium	Rhodium and ruthenium	Total
	Ores of platinum metals (platinum content)	Grain, nuggets, sponge, or scrap	Ingots, bars, sheets, or plates not less than ⅛-inch thick					
Argentina		154						154
Australia			250					250
Canada		781		1			25	807
Chile		2,085						2,085
Colombia		29,119						29,119
France							99	99
Germany					110		44	154
Japan			303					303
Mexico		189						189
Palestine			3			40		43
Panama		4						4
Philippine Islands		108						108
U. S. S. R. (Russia)			4,500	250				4,750
United Kingdom	2,204	70,681	46,957	2,417	5,937	38,802	5,369	172,367
	2,204	103,121	52,013	2,668	6,047	38,842	5,537	210,432

Platinum metals imported for consumption in the United States, 1932–36

Year	Troy ounces	Value	Year	Troy ounces	Value
1932	56,047	$1,417,037	1935	164,149	$4,228,022
1933	162,081	3,939,846	1936	210,440	5,996,034
1934	174,312	4,157,518			

Exports.—Although a complete record of exports of platinum in 1935 is not available because shipments by parcel post were not recorded, it is believed that the export trade in platinum increased notably in 1936. Exports of unmanufactured products were 55,454 ounces, of which Japan took 28,869 ounces, France 10,247 ounces, and the United Kingdom 8,187 ounces.

Platinum exported from the United States in 1936, by countries

[Includes exports by parcel post]

Country	Unmanufactured (ingots, sheets, wire, alloys, and scrap)		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value
Argentina			2	$152
Australia	5	$125		
Bolivia			1	73
Brazil	448	19,615	90	4,487
Canada	325	11,266	35	2,182
Chile	39	1,065	11	448
China	3	185	100	1,493
Colombia	26	1,192	1	25
Cuba	20	686	(1)	27
France	10,247	381,779		
Germany	6,616	210,664		
Hong Kong	(1)	15	25	1,362
Japan	28,869	1,086,030	312	19,499
Mexico	3	366	20	1,245
Netherland West Indies			5	269
Palestine	14	392	331	12,078
Philippine Islands	19	759		
Salvador	(1)	29	1	38
South Africa, other British			13	868
Switzerland	(1)	38		
Turkey in Asia and Europe	633	22,938	12	491
United Kingdom	8,187	332,061	1,631	79,154
	55,454	2,069,205	2,590	123,891

[1] Less than 1 ounce.

Platinum exported from the United States, 1932–36 [1]

Year	Unmanufactured		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value
1932	20,106	$665,029	2,032	$107,396
1933	23,686	608,552	1,323	56,812
1934	1,897	83,337	759	35,456
1935	3,271	105,895	1,954	84,601
1936	55,454	2,069,205	2,590	123,891

[1] Excludes exports by parcel post from July 1933 to December 31, 1935.

PRODUCTION IN FOREIGN COUNTRIES

Belgian Congo.—According to a report of the Imperial Institute:[2]

Platinum and palladium occur in association with the copper ores of Katanga and are recovered as a byproduct in the electrolytic refining of copper by the Société Générale Métallurgique d'Hoboken of Antwerp, Belgium. The ores are said to contain about four times as much palladium as platinum.

Platinum is also reported to occur in association with gold in the alluvials of Kilo, among the headwaters of the Ituri River, west of Lake Albert. A more interesting occurrence, however, is that at Ruwe, near the source of the Lualaba, in southwest Katanga, where platinum and palladium are associated with gold, silver, and more or less iron, cobalt, nickel, lead, and copper. The ore body occurs in an indurated, banded sandstone and is some 1,200 ft. in length, varying in width from 3 to 20 ft. with an average of 8 ft. The lead and copper occur as vanadates, while pyromorphite and malachite are present and are said to act as indicators. Platinum, palladium, and silver increase or decrease in quantity together, but gold values are said to be independent of these.[3] Below the outcrop of the ore body is an eluvial deposit containing nuggets of gold up to 2 in. in diameter, but platinum seems to be practically absent.

According to the annual report of the Union Minière du Haut Katanga for 1908, the gold and platinum reef at Ruwe contains about 3 dwt. of gold and 9 dwt. of platinum metals per ton.

The eluvial deposit was worked for many years in the early part of the century, and at the present time the tailings dumps from these old workings are being treated for gold, while investigations are proceeding on the ore body itself.

The production of platinum and palladium was 965 and 5,144 ounces, respectively, in 1935 compared with 1,254 and 3,569 ounces, respectively, in 1934.

Canada.—Virtually the entire Canadian output of metals of the platinum group is recovered in refining nickel-copper matte from the Sudbury district of Ontario. Residues obtained in the metallurgical treatment of the nickel-copper matte are refined by the International Nickel Co. of Canada, Ltd., at its refinery at Acton, England, which has an annual capacity of 300,000 ounces of platinum-group metals. Recoveries of platinum metals from the nickel-copper ores in 1936 were 131,551 ounces of platinum and 103,671 ounces of other platinum-group metals compared with 105,335 ounces of platinum and 84,772 ounces of other platinum-group metals in 1935.[4]

British Columbia placers yielded only 39 ounces of stream platinum in 1936 compared with 20 ounces in 1935.

Colombia.—Colombia exported 38,333 ounces of crude platinum in 1936 (38,020 ounces in 1935), of which 20,765 ounces (23,363 ounces in 1935) were the output of dredges and 17,568 ounces (14,657 ounces in 1935) the product of hand-working by native operators.

The South American Gold & Platinum Co. produced 26,446 ounces of crude platinum and 48,036 ounces of crude gold in 1936 compared with 27,414 ounces of crude platinum and 44,846 ounces of crude gold in 1935.

Ethiopia.—The production of crude platinum in Ethiopia was 8,038 ounces in 1936 compared with 6,320 in 1935.

Germany.—Although the production of platinum metals in Germany is confined to small quantities of platinum and palladium recovered as byproducts in the treatment of copper ores, the country is important in the international platinum trade. It is the largest European

---

[2] Imperial Institute, Mineral Resources Department, London, Reports on the Mineral Industry of the British Empire and Foreign Countries, Platinum and Allied Metals: 1936, pp. 97–98.

[3] Ball, S. H., and Shaler, M. K., Mining Conditions in the Belgian Congo: Trans. Am. Inst. Min. Eng., vol. 41, 1910, p. 195.

[4] Dominion Bureau of Statistics, Preliminary Report on the Mineral Production of Canada During the Calendar Year 1936: Ottawa, 1937.

consumer of platinum and has an important fabricating industry. Before the World War, Germany had an important platinum-smelting industry at Hanau, a suburb of Frankfurt-am-Main, which depended chiefly on the U. S. S. R. for its crude material. After the war, Russian platinum was distributed in the form of metal, and Germany had to discontinue smelting the ore. The plants at Hanau, however, import platinum metals, which are fabricated into products for various industries.

Imports of platinum metals and alloys into Germany increased from 84,981 ounces in 1935 to 525,883 in 1936. The chief sources of supply in 1936 were U. S. S. R. (451,567 ounces) and Great Britain (42,770 ounces). The U. S. S. R. (23,959 ounces), Switzerland (22,174 ounces), and Great Britain (20,747 ounces) were the chief sources of supply in 1935. The phenomenal gain in imports into Germany in 1936 was reported to be due to the inclusion of certain platinum-bearing material, such as platinum sweeps, electrolytic muds, used-up platinum contact material, and scrap, which should properly be classified elsewhere.

Exports of platinum metals and alloys from Germany decreased from 102,288 ounces in 1935 to 32,553 in 1936. Great Britain received only 3,733 ounces in 1936 compared with 50,573 in 1935. Presumably the large exports to Great Britain in 1935 were due to the transfer from Berlin to London of platinum belonging to the Soviet Government.

The following table on platinum metals and alloys imported into and exported from Germany indicates the trend in consumption, because the country depends almost entirely on imports.

Platinum metals and alloys imported into and exported from Germany, 1932–36, in ounces

Year	Imports	Exports	Year	Imports	Exports
1932	107, 605	22, 342	1935	84, 981	102, 28[illegible]
1933	114, 151	82, 177	1936	[1] 525, 883	32, 55[illegible]
1934	73, 641	72, 304			

[1] Includes platinum sweeps, electrolytic muds, used-up platinum contact material, and scrap.

Sierra Leone.—The production of crude platinum in Sierra Leone in 1936 was 484 ounces compared with 750 in 1935.

Tasmania.—The production of osmiridium in Tasmania in 1936 was 281 ounces compared with 235 in 1935. The Adams River field continued to be the chief producing area, although the northwestern fields yielded small quantities.

Union of South Africa.—According to the Department of Mines and Industries, sales of platinum in South Africa in 1936 were 29,044 ounces valued at £176,292 (£6.07 an ounce) compared with 31,338 ounces valued at £179,697 (£5.73 an ounce) in 1935. The average composition of the product shipped in 1935 was platinum 77.75 percent, palladium 15.82 percent, iridium 0.05 percent, ruthenium 0.91 percent, and gold 5.47 percent.

Sales of osmiridium in 1936 amounted to 5,018 ounces valued at £27,297 (£5.44 an ounce) compared with 5,278 ounces valued at £24,460 (£4.63 an ounce) in 1935. The average composition of the product shipped in 1935 was osmium 32.79 percent, iridium 28.45

percent, ruthenium 13.15 percent, platinum 11.26 percent, gold 0.52 percent, rhodium 0.55 percent, and undetermined 13.28 percent.

U. S. S. R. (*Russia*).—No authentic statistics on the production of platinum in the U. S. S. R. in recent years are available. However, it is generally estimated that an annual output of 100,000 ounces of crude platinum has been maintained.

WORLD PRODUCTION

World production of platinum and allied metals, 1932–36, in troy ounces

[Compiled by M. T. Latus]

Country and product	1932	1933	1934	1935	1936
Australia:					
New South Wales: Placer platinum	336	113	180	98	47
Tasmania: Placer osmiridium	785	548	488	235	281
Belgian Congo: From refineries—					
Palladium	2,025	547	3,569	5,144	(1)
Platinum	96		1,254	965	(1)
Canada:					
Placer platinum	59	40	53	20	39
From refineries: [2]					
Platinum	27,284	24,746	116,177	105,335	131,551
Other platinum metals	37,593	31,009	83,932	84,772	103,671
Colombia: Placer platinum (exports)	16,055	44,543	54,216	38,020	38,333
Ethiopia: Placer platinum	4,823	3,215	5,644	6,320	8,038
Japan: Placer platinum	267	207	118	51	(1)
New Zealand: Placer platinum		4		14	(1)
Panama: Placer platinum				16	19
Papua: [3]					
Placer platinum	2		96	46	21
Placer osmiridium	1	29	4	9	17
Sierra Leone: Placer platinum	531	431	474	750	484
Union of South Africa:					
Platinum (content of platinum metals) [4]	7,766		26,369	19,954	19,746
Concentrates (content of platinum metals) [4]	1,480	2,386	11,372	11,317	13,163
Osmiridium [5]	6,523	6,712	5,088	5,047	5,431
U. S. S. R. (Russia): Placer platinum [6]	100,000	100,000	100,000	100,000	100,000
United States:					
Placer platinum	1,074	1,266	3,720	9,069	9,785
Ore (content of platinum metals)					110
From refineries: [7]					
Platinum	1,694	1,050	1,062	1,361	4,443
Other platinum metals	1,150	707	1,273	1,122	4,541

[1] Data not available.
[2] Recovered from nickel-copper mattes.
[3] Year ended June 30 of year stated.
[4] Produced from platinum ores.
[5] Produced from treatment of gold ores on the Rand.
[6] Approximate production.
[7] New platinum recovered in gold and copper refining of domestic material.

MINOR METALS

By Paul M. Tyler [1]

SUMMARY OUTLINE

For thousands of years the world's needs with respect to metals were supplied mainly by iron, copper, lead, and zinc supplemented by small amounts of tin and antimony. Even as recently as the beginning of the present century gold, silver, platinum, and a few minor elements virtually completed the list of useful metals. The sharp rise in factory production during the nineteenth century resulted in an enormous increase in demand for fuels and metals, but no corresponding increase occurred in the variety of metals in general use. Since 1900, however, the number of metals in active use has more than doubled, and research still proceeds swiftly to expand our knowledge and, if possible, our utilization of all the 92 elements. Discovery of uses for byproduct metals recovered from wastes of smelting and refining industries has been largely responsible for the wider utilization of the less well-known metals.

This review includes several elements, such as barium and sodium, whose compounds, in the form of nonmetals (for example, barite and salt), are discussed in other chapters of this volume. Several of the more important so-called "minor" metals likewise are discussed in separate chapters, including some that were covered in the Minor Metals chapter of former volumes of Minerals Yearbook. The present review, however, includes a rather large number of less well-known or really rare elements that have not been mentioned hitherto in this series. The Bureau of Mines receives numerous inquiries regarding all the elements, and this chapter is intended to meet the demand for information as to the commercial status of production and utilization of these miscellaneous metals.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

A convenient classification of the elements is the periodic table credited to Mendeleef, wherein the elements are ranked in order of increasing atomic weight. For the greater convenience of nontechnical readers, however, the subsequent discussion takes up the specified metals in alphabetical order.

ACTINIUM

Actinium (element 89), is one of the disintegration products of uranium. Uranium ores contain actinium, but in much smaller quantities, even, than radium. According to some authorities, uranium decomposes into two series or families of radioactive elements, 97 percent going to form the radium series and 3 percent proceeding through the much shorter series of transformations that constitute the actinium series. Actinium has been extracted from pitchblende. It disintegrates rather slowly, requiring some 13½ years to decay to half value, but none of the actinium series has much economic significance compared to radium or mesothorium.

ALABAMINE

In 1931, Dr. Fred Allison and coworkers at Alabama Polytechnic Institute reported the discovery, by magneto-optic methods, of element 85, which hitherto had been inferentially called eka-iodine, but which he named alabamine. If the identification of virginium is definitely accepted, alabamine was the last of the 92 elements to be discovered. Inasmuch as its existence in the earth's crust was long doubted, alabamine obviously is too rare even to be classed as a laboratory curiosity. The discoverer reports the preparation in his laboratory of a "concentrate" containing only about 2 parts of alabamine per million in the form of lithium alabamide. The greatest natural concentration hitherto found seemed to be of the order of 1 part in 100 million.

BARIUM

Barium (element 56) one of the alkaline-earth group, is a gray metal that melts at 850° C. and boils at 1,140° C. It looks like lead and is easily cut by a knife but is hardly one-third as heavy (specific gravity 3.5) and oxidizes rapidly. Formerly quite expensive—$450 a pound, or more—barium was reduced in price to less than $10 a pound in 1932 and now costs less than $7.50. Barium compounds, being made from barite or witherite, are cheap, and the price of the metal could be reduced greatly if tonnage outlets could be found. For the present, however, there is little use for the metal except for ignition equipment; the nickel wire used for automobile spark-plug points frequently contains a small percentage of barium. A little of it has also been used for cleaning up the last traces of gas ("flashing") in vacuum tubes. However, aside from its extraordinary electron-emitting properties, barium metal inherently has little to recommend it commercially in lieu of calcium or even sodium, both of which can be made more cheaply per pound and are much more efficient for most chemical reactions. Even for certain thermionic emission purposes, barium compounds can be employed without first reducing them to the metal. At least two American companies have produced barium metal commercially, and it has been made, also, in Germany, France, Great Britain, and possibly other countries.

BERYLLIUM

Beryllium, or glucinum, as it is called in England (element 4), is a very light metal having about the same density as magnesium, although as rigid as steel, and possessing other interesting properties in its unalloyed state. Nevertheless, it seems destined always to be too expensive to be used extensively, except as a hardening agent for other metals. At present the rather small amount of beryllium consumed is principally in the form of beryllium-copper alloys containing about 2.25 percent beryllium. These alloys, properly heat-treated, have high tensile strength and remarkable ability to withstand repeated stress. They are widely employed instead of phosphor bronze in spring contacts, contact clips, and sundry small parts for office machines and other light mechanical devices. For many such purposes, where wear and corrosion resistance or high fatigue values, combined with good electrical conductivity, are essential, beryllium-copper has no real competitor, even though it costs 97 cents to $1.50 a pound in standard commercial shapes and sizes—sheets, plates, rods, wire. It is nonmagnetic, and its nonsparking characteristics have led to its utilization in various safety tools, especially for use around gas works and petroleum refineries. Hand hammers, chisels, wrenches, wrecking bars, drift pins, and scrapers of beryllium-copper are on the market, and the alloy is used to make pistons for vibrators; firing pins in revolvers, rifles, and shot guns; precision bearings of various kinds; ball cages, bushings, platers' bars and cores, surgical instrument handles, and valve parts; and for wire cloth such as is used in the rubber industry for filtering abrasive materials, and possibly in paper-making machines. Of some importance is the use of the alloy for plastic molding dies; due to the higher heat conductivity of beryllium-copper (about twice that of steel), the cycle for certain plastic parts has been decreased to one-sixth of its former time.[2] The claim is made [3] that copper-beryllium-cobalt alloys are cheaper than beryllium-copper alloys and are better conductors of electricity.

A great deal of publicity has been given the light-metal alloys of beryllium and their possible use in aircraft, but commercial developments have been unimportant. More promising is the use in iron alloys, particularly nickel-iron and nickel-chrome-iron. In Germany a good deal of work has been done on nickel-beryllium alloys, which are very strong. A nonmagnetic, highly corrosion resisting, beryllium-nickel-chrome-iron alloy is being used for heat-resistant springs and even for winding springs in watches.[4] Small additions of beryllium have been made to silver to improve tarnish resistance, but the anticipated improvement did not take place under all testing conditions.

Beryllium metal has not been produced commercially in the United States, and world supplies have consisted chiefly of a 98-percent product made in small quantities in Germany since about 1927. In September 1935 the nominal quotation of this metal was dropped from 600 marks to 500 marks a pound. Master alloys of beryllium with copper, nickel, and iron have been made in the United States by the Beryllium Corporation of Pennsylvania, or its predecessor corporations

[2] Silliman, H. F., Beryllium-Copper Alloys: Ind. and Eng. Chem., vol. 28, no. 12, 1936, pp. 1424–1428.
[3] Benford, F. G., Beryllium-Copper-Cobalt Alloys: Metal Ind. (London), vol. 49, no. 2, July 10, 1936 p. 40.
[4] Stott, L. L., Properties and Alloys of Beryllium: Am. Inst. Min. and Met. Eng. Tech. Pub. 738 (Metals Technol.), 1936, 17 pp.

since about 1929 and have been sold at $30 to $40 per pound of contained beryllium. Until 1935, when its plant facilities were transferred from Marysville, Mich., to Temple, Pa., this company, which has a working agreement with the German producers, was the only producer of beryllium alloys in this country, but in that year the Westvaco Chlorine Products Co. entered the field. The operations of the latter company, however, are still more or less in the experimental stage. The Brush Beryllium Co., Cleveland, Ohio, has been an active producer of beryllium oxide and compounds for several years; and late in 1936, after developing a new process, it entered the metallic field, offering beryllium-copper master alloy at a new low price of $23 per pound of beryllium content.

The commercial production of beryllium-copper alloys in the United States dates from 1932, or about the time that the reorganized Beryllium Corporation of America offered the American Brass Co. a 12- to 13-percent master alloy of good quality. The development of wrought alloys was begun under the direction of the late H. W. Bassett, but both the American Brass Co. and the Riverside Metal Co. have contributed to the rapid progress made in commercial production and sales of rolled and drawn products. Commercial castings also may be had at this time from several companies. The Beryllium Corporation of Pennsylvania offers three grades of heat-treated beryllium-copper castings; one of these has an ultimate tensile strength of 145,000 pounds per square inch with only 1 percent elongation, while another retains 75,000 pounds per square inch with 12 percent elongation.

Notwithstanding a voluminous patent literature, details as to commercial processes used in the manufacture of beryllium metal are not widely known. It seems to be generally assumed, however, that the Beryllium Corporation of Pennsylvania still makes the metal by electrolysis in a fluoride bath, whereas both the new producers employ nonelectrolytic processes with the oxide as a starting point.

Beryllium oxide has some highly useful properties—a melting point of about 2,570° C., great strength, low density, retention of electrical insulation properties at high temperature, and extraordinary resistance to thermal shock. For several years a relatively large proportion of the beryllium ores consumed in the United States has been made into beryllium oxide or other compounds for use chiefly as a superrefractory in crucibles, boats, electric-furnace walls, vacuum tubes, and electric-lamp parts. Recently,[5] beryllium salts have been used instead of cobalt compounds to increase the light-fastness of lithopone, as they do not detract from the whiteness or brilliance. Sintered beryllium oxide is a high-duty abrasive suitable for grinding or polishing hard alloys.

According to the latest price list of the Brush Beryllium Co., beryllium oxide, fluffy, 99.8 percent, calcined at 1,450° C., for refractory crucibles and electrical insulators, can be bought at $4 per pound in 100-pound lots; sodium-beryllium fluoride ($2NaF.BeF_2$) for electrolytic or fluxing uses costs $4.30 per pound (5-pound lots); beryllium nitrate ($Be(NO_3)_2.3H_2O$) costs $3 per pound (5-pound lots); and crystalline beryllium sulphate ($BeSO_4.4H_2O$) for reagent use costs $0.65 per pound (50- to 100-pound lots). Higher prices are charged for smaller quantities.

[5] Chemical Trade Journal (London), Beryllium Compounds in Lithopone Industry: Vol. 99, no. 2576, Oct. 2, 1936, p. 286.

Beryl.—In 1936, beryl, the only commercial ore of beryllium, continued to be quoted at $30 a short ton for the 10-percent BeO grade and $35 a ton for 12-percent grade, f. o. b. mines. These quotations are nominal, and actual business is contractual. The New York delivered price in 1936 was around $40 a ton. Whereas those who have beryl to sell may experience difficulty at present in disposing of their product promptly, the demand is growing, and a far better price would be paid to a shipper who could deliver regular shipments than to one who can offer only an occasional odd lot. Ore supplies long have been the main deterrent to more rapid development of the beryllium industry. Recently the situation has improved, but some of this loosening up of supplies has represented accumulations or recoveries from dumps at pegmatite mining operations in various parts of the world, and the question as to just how much newly mined beryl can be obtained regularly year after year has not been answered. The revival of lithium and feldspar mining in South Dakota has stimulated domestic production. Colorado, Nevada, and perhaps other States promise to yield substantial supplies, and small amounts already have been obtained in New England, New York, Virginia, and North Carolina. In Canada, the Renfrew Minerals, Ltd., organized in 1933, reported further development of its extensive pegmatite deposit during 1936.

American needs recently have been supplied principally from British India, but in 1936 imports amounting to 162 short tons valued at $6,681 came from Argentina, except for small shipments from Brazil (3,241 pounds) and the Union of South Africa (11,091 pounds).

Brazilian beryl has been shipped to Europe, chiefly to Germany and Italy. South Africa, which produced 58 short tons and exported 22.4 tons assaying 12.3 percent BeO in 1935, seemed to be developing as a really important source, but the Namaqualand deposits, upon further investigation, appear to be unworkable until the general development of the area provides better transportation facilities. No reports have been received as to 1936 activity in Madagascar, an occasional producer. In Austria, the old Smaragd mine in Salzburg Province near Bramberg is again in operation, and small crystals have been recovered for the production of beryllium, according to a communication to the Bureau of Mines from Dr. Karl Mautner of Vienna.

Probably the best ore offered in the United States is from British India, which runs over 13 percent BeO, although some South American shipments run 12.2 percent compared with 11 to 11.5 percent for South Dakota beryl.

No statistics are available as to either production or consumption of beryl for the United States or for the world. Undoubtedly domestic consumption is increasing, having recently risen to perhaps 300 tons annually, while 500 tons annually is a reasonable prospect in the near future. The last figure represents a metal output of 25,000 to 30,000 pounds a year, which, at $20 a pound, would indicate total gross sales of around $500,000.

BORON

Although possessing many of the characteristics of a metal, boron (element 5), is more properly described as a "metalloid", a designation that it shares with such elements as arsenic, phosphorus, and sulphur, as well as with carbon, which it resembles in certain respects. Whereas the use of borax and sundry other boron compounds is increasing,

boron itself has few commercial applications. It is one of the hardest known substances, but for abrasive uses boron carbide is employed commercially—a compound that excels in hardness silicon carbide, tungsten carbide, artificial aluminous abrasives, sapphire, and, in fact, all known substances except the diamond. Boron alloys, which find a limited use in steel making and in the nonferrous-metals industries, are supplied by domestic manufacturers. Powdered boron (95 percent) is offered at $25 a pound; boron carbide is worth around $7 a pound; ferroboron (18 percent B) costs about $5 a pound of alloy; and boron suboxide and boron fluoride (gases) also sell for $5 a pound.[6] Sodium borate (ordinary borax) sells by the ton at the equivalent of 2¼ cents a pound.

Imports into the United States in 1936 included 1,538 pounds of boron carbide valued at $2,204 and 300 pounds of ferroboron valued at $536. In addition, according to the Tariff Commission, 12,496 pounds of boron fluoride valued at $10,053 came into the port of New York from Germany in 1936.

CAESIUM

Caesium, or cesium, (element 55) is an alkali-group metal so active chemically that, if unprotected, it will combine violently with the moisture, oxygen, and carbon dioxide of the atmosphere. Its salts are increasingly important, due to their use in the photocell industry. A "pill" composed of caesium chloride mixed with metallic magnesium or calcium may be introduced into certain kinds of radio tubes and flashed to coat the filament with caesium. According to more recent practice, however, caesium chromate is used instead of caesium chloride, and metallic silicon or tantalum instead of magnesium or calcium. In caesium photoelectric cells, without which we would have no talking motion pictures, the film of caesium formed on the silver or other base-metal electrode is only 1 molecule thick.[7] A hint as to the magnitude of this business is given by the report[7] that Russia alone is producing 800 grams of caesium salts a month and that Soviet needs already may be about 12 kilograms of caesium and rubidium annually and are likely to increase. In addition to their use as a gas absorber in radio tubes and to create a metallic vapor in power tubes and the important light-sensitive coating for the plates of photoelectric cells, caesium salts may be used in medicine, in fulminates, in fire-extinguishing compounds, and for sundry minor purposes, Metallic caesium has so low a melting point (28.5° C.) that it becomes liquid on a fairly warm day, and this, combined with the fact that it is costly to produce and difficult to protect from oxidation, discourages commercial use of the metal wherever its salts can be used instead. However, the metal can be purchased at $1 a gram or less. Sometimes it is supplied in sealed capsules, which are filled with an oil. The principal compounds are the chloride and the chromate, both of which are offered at $0.45 a gram.

Pollucite is the only mineral that can be considered primarily an ore of caesium. It occurs in certain pegmatites and has been mined in New England, but it is far from common. Caesium, however, also occurs in lithium ores, particularly lepidolite, from which it has

[6] Quotations furnished by A. D. Mackay, New York, N. Y.
[7] Fink, C. G., Rare Metals and Minerals: Mining and Metallurgy, vol. 18, no. 361, January 1937, p. 23.

been extracted commercially. Three companies, the Fansteel Metallurgical Corporation of North Chicago, Ill., the Maywood Chemical Co., Maywood, N. J., and the Calirare Chemical Corporation, Los Angeles, Calif., produce caesium salts in the United States. Caesium and its salts are also made in Germany, in the U. S. S. R. (Russia), and possibly in other European countries. Imports are not listed separately in the official statistics, but probably come only from Germany and are small in amount.

CALCIUM

Calcium (element 20) is the only alkaline-earth metal that has been used commercially on even a moderately extensive scale, and its consumption in the metallic condition still is small compared with the enormous consumption and cheapness of lime and other calcium compounds. It is fifth in order of abundance among elements in the earth's crust. Calcium metal is only about one and one-half times as heavy as water, melts at 810° C., and boils around 1,440° C. Although oxidizing quickly in the air and chemically active enough to decompose water, it can be handled without danger to the skin.

Frary metal and other lead alloys containing small percentages of calcium as a hardening agent have been in use for 20 years or more but are made by electrolyzing a lead bath covered with molten calcium chloride rather than by adding calcium metal. A long list of patents testifies to the vast number of potential uses of calcium, but specific uses[8] are refining (debismuthizing) of lead, preparation of lead alloys, especially cable sheaths and battery plates, deoxidizing copper, preparation of copper alloys, making of bearing bronzes of the high-lead type, and deoxidizing and grain-refining cast iron, nickel, and nickel alloys, particularly iron-nickel and chromium-nickel. Calcium has been used also as a reducing agent in the preparation of chromium metal powder, thorium, and uranium, as an alloying, purifying, and modifying agent in aluminum, magnesium, and beryllium alloys; and as a "getter" in electrical discharge devices and vacuum tubes. Suggested uses include desulphurization and refining of petroleum and sundry extensions of its laboratory uses for removing from gases and liquids the last traces of oxygen, moisture, and other substances with which it reacts readily. Merely as a reducing agent, sodium is much cheaper and more efficient than calcium, but calcium has other advantages that tend to extend its uses, especially for several metallurgical purposes. Recently, calcium has been used in alloy steel—such as ordinary 18/8, 18/25 Cr, 8/10 Ni, 25/30 Ni, and free-cutting selenium-stainless steels—because it inhibits formation of carbides, promotes clean boundaries and uniform grain structure with no mottling or clouding, and makes unnecessary the addition of ferrosilicon. Certain chrome-nickel alloys may be forged after calcium treatment.

Until about 1918 the price of calcium metal was prohibitively high (it was unobtainable at less than about $20 a pound), but later it was reduced to $1.50, world production increasing gradually to possibly 25 tons a year, chiefly from France. The metal had been produced in this country only experimentally or on a very small scale before 1936, when the Electro Metallurgical Co. began making it at

[8] Mantell, C.L., and Hardy, C., Calcium, Its Metallurgy and Technology: Electrochemical Soc. Preprint 66-18, 1934, p. 193.

Niagara Falls, N. Y., using calcium carbide instead of calcium chloride as the raw material. In quantities of 1 ton or more, calcium can be bought for 75 cents a pound.

Imports of calcium are reported under a general classification that includes barium, boron, strontium, tantalum, titanium, zirconium, and sundry other metals, the total imports for the group amounting in 1936 to only 17,118 pounds valued at $13,219.

COLUMBIUM

Prior to about 1929, columbium (element 41), called niobium in Great Britain, had little or no industrial application. Except for about one-half ounce made in Germany in 1906, the metal had never been produced commercially until it was put on the market experimentally by the Fansteel Products Co. in 1928, although previously a small amount had been used in steel making in the form of a joint alloy with its sister metal tantalum, which accompanies it in most ores. In 1933, however, Becket and Franks reported their discovery that columbium inhibits intergranular corrosion of high-chromium steels, and subsequently ferrocolumbium has become an important alloy for the manufacture of weldable high-speed steels. In 1936 fully 40 tons of ferrocolumbium were sold in the United States, and the demand for columbo-tantalites increased substantially. Whereas only a few years ago the columbium content of even high-grade ores was not paid for, as much as £6 15s. a long-ton unit has been offered for mixed ores containing as low as 60 percent $Cb_2O_5+Ta_2O_5$. American supplies of columbite are drawn from Nigeria, where the mineral, containing negligible amounts of tantalum, accompanies tin ore; 498 short tons of this columbite valued at $257,666 were imported into the United States in 1936. The main producer is Jantar Nigeria Co., Ltd., which reports proved reserves of 6,000 short tons; other Nigerian producers are Minerals Research Syndicate, Ltd., African Prospectors, Ltd., Gold Coast Lands, Ltd., and West African Mines and Estates, Ltd. It is reported that columbo-tantalite likewise is being produced in the Belgian Congo as a byproduct of the tin operations of Geomines at Manono, Katanga. Ferrocolumbium, made only at Niagara Falls as a 50-percent alloy, sells for $2.50 a pound of contained columbium. Columbium metal, now used in electronic tubes, is quoted at $560 a pound for base sizes of rod and at $500 a pound for sheet.

GALLIUM

Gallium (element 31) is a rare metal of the aluminum group, rather hard, but, like caesium, becoming liquid at a temperature only slightly above that of an ordinary room. It is a byproduct of the zinc industry and also occurs in some coal ashes. The price has been progressively reduced until now it could be bought in lots of several pounds at $1.50 a gram, although about $3 a gram is charged for the small quantities that suffice for ordinary experimental or educational laboratory needs. Outside of its occasional use in medium-high-temperature thermometers, for which purpose it is enclosed in quartz glass, gallium seems to have found no commercial applications.

GERMANIUM

Germanium (element 32), although far from being abundant in nature, could be recovered in rather large quantities in the form of its oxide, as a byproduct of zinc. It could also be recovered from various kinds of coal—an English coal, for example, is reported to yield an ash containing 1.6 percent GeO—and germanium sulphide might be obtained in considerable amounts from Bolivian tin-silver mines. Research has not yet found uses for this element, although it may be employed for coating mirrors and in therapy for combating anemia. The metal is crystalline gray white and does not tarnish rapidly. Its chemical properties are intermediate between those of silicon and tin. Germanium (99 percent) can be bought for $5.50 a gram and the oxide (99 percent) for $3.50 a gram.[9]

HAFNIUM

Although hafnium (element 72) appears to be one of the more abundant of the recently discovered elements, and consequently has commanded much scientific attention, as yet the only demand seems to have come from scientists who have investigated its properties or from radio-research laboratories. Hafnium occurs in minor amounts with its sister element, zirconium, which it resembles in many respects and from which it is separable only with great difficulty. The metal has a high electronic emissivity and a high melting point, probably over 2,200° C., higher even than most of the platinum metals. Ores carrying about 3 percent hafnia have been offered at 50 cents a pound, and hafnium oxide and chloride have been obtainable at approximately $25 a gram, but these prices are nominal in the absence of any real business. Specimens of the metal can be purchased for $1.50 per milligram.

INDIUM

Indium (element 49), a soft silvery metal of the aluminum group, is another electrolytic zinc byproduct that could be obtained in fairly substantial quanties. At certain plants, as much as 1 pound of indium can be recovered for each ton of zinc produced. An imposing list of prospective uses has been investigated, but actual consumption seems to be small, although metallic indium may be used in silverware, in medicine, for alloys that melt in hot water, and possibly for sundry other minor uses. The metal (99.5 percent) could be bought for 40 cents a gram in a large quantity, but ordinarily $1 a gram is asked.

LITHIUM

Lithium (element 3) is the lightest solid substance known, being only half as dense as water. At room temperatures it can be handled as easily as calcium, but it does react slowly with air (particularly with the nitrogen, if moisture is present) and is otherwise unsuited for engineering uses when unalloyed. Alloys of lithium and aluminum, lead, zinc, and probably magnesium appear to be of value in engineering,[10] and lithium may be used as a scavenging agent for iron, copper, nickel. and their alloys. Lithium-copper and lithium-treated conductivity

[9] Quotations furnished by A. D. Mackay, New York, N. Y.
[10] Osborg, H., Lithium, Theoretical Studies and Practical Applications: Electrochem. Soc., 1935, 68 pp.

bronzes are now produced on a fairly large scale, and for a number of years there has been a steady output of lithium-hardened bearing-metal alloys. The therapeutic properties of lithium salts were utilized generations ago; "lithiated" mineral waters still account for a substantial consumption of lithium chloride, while citrate and salicylate are still prescribed as remedies for rheumatism. Of outstanding interest, however, is the fast-growing use of lithium chloride for air-conditioning. Lithium metal costs as much as $20 a pound, but lithium chloride (97 percent) was quoted at the close of 1936 at $1.85 a pound and costs only $1.40 a pound in ton lots,[11] and the carbonate (98 percent) was offered at $1.25 to $1.30 a pound and the fluoride at $2 to $2.50 a pound, all packed in barrels.

MASURIUM

Two elements of the manganese family long escaped detection. Some years ago they were described inferentially as eka-manganese and dvi-manganese, and their properties were forecast fairly acurately; but it remained for Noddack and Tacke (later Frau Noddack) in 1925 to find these elements, which they named masurium (element 43) and rhenium (element 75), respectively. The Noddacks and others have charted the spectrum lines of the telltale flame of masurium, but even so it is merely a name, and the nearest approach to commercial development has been the offering by rare-mineral dealers of specimens of molybdenite that may betray traces of its presence in the spectrograph.

POLONIUM

Polonium, or radium F (element 84), was the first radioactive element discovered by Madame Curie in 1898. It is near the end of the uranium-radium series and, being relatively short-lived (half life, 140 days) and soon changing to inert lead, has little commercial significance. Nevertheless, it is of sufficient scientific interest to justify the recent publication of a 29-page monograph.[12] Aside from valuable applications in nuclear physics, polonium is used at times in physiological research. It may be recovered from radium-lead residues and old radium ampules.

POTASSIUM

Potassium compounds are well known, and potash is one of the three principal plant foods. The metal (element 19) was the first to be isolated from an oxide by electric current. Although Davey made it in this fashion as early as 1807, potassium metal has never had real commercial significance, inasmuch as it costs more per pound and for almost every purpose is less efficient than sodium. A sodium potassium alloy exists as a liquid at ordinary temperatures, and a procedure has been perfected for making it. Domestic consumption at present probably does not exceed about 50 pounds a year, all of which comes from Germany. In lots of over 10 pounds the price (as reported by Charles Hardy, Inc., New York, N. Y.) is $12.50 to $14 a pound.

---

[11] Quotation furnished by Foote Mineral Co., Inc., Philadelphia, Pa.
[12] Haïssinsky, M., Electrochemistry of Polonium: Trans. Electrochem. Soc., vol. 70, 1936, pp. 343–371.

RADIUM

By far the best known of the series of radioactive elements resulting from the disintegration of uranium is element 88 radium. It is widely used in therapeutics, chiefly for treatment of cancer. Smaller amounts are used industrially, principally as the activating agent for luminous paints used on watch dials, electric switch buttons, compasses, and elsewhere. More recently it has come to be used for radiograph testing of metal objects; this technique permits discovery of incipient weakness in large castings or forgings and supplements X-ray examinations. Formerly, radium appeared on the market generally as the bromide, packed in small, sealed, glass tubes or ampules; but nowadays radium sulphate is the usual compound, and it is packed in metal needles or tubes (about 1.7 mm in diameter) generally platinum. An outer case of lead is customarily employed to decrease danger of handling. The soluble salts, notably the bromide but also a little chloride, are sold only for emanation (radon) plants. The metal, which resembles barium in its general properties, was isolated by Madame Curie and a coworker in 1911, but it has not come upon the market.

Radium has been acclaimed as one of the most effective contributions of science toward alleviating human misery, but probably not more than about 26 ounces have so far been produced in the entire world. Roughly, half of this output has come from the Belgian Congo. Second in point of production is the United States, which produced the most radium from 1913 to 1922, when the richer and larger deposits of the Belgian Congo became productive. Almost no radium has been produced in this country since 1923. After that year the United States, although still the world's largest consumer, has met its needs by importations. A little carnotite is mined in Utah and Colorado, but it has been used as a source of uranium compounds, for radioactive drinking water and other therapeutic purposes, and as an experimental fertilizer for citrus crops. Considerable doubt has been expressed as to the real value of these radioactive preparations either medicinally or for stimulating plant growth, and production for these uses accordingly has been somewhat sporadic. On the other hand, the growing demand for uranium salts recently has stimulated greater activity in the Utah-Colorado area, where vanadium production has been resumed in well-organized fashion. These developments are discussed in greater detail in the chapter of Minerals Yearbook on Vanadium. The U. S. Vanadium Corporation, which during 1936 completed a 100-ton mill for treating carnotite, may also produce uranium or radium.

Czechoslovakia pioneered in the production of radium, which is recovered under Government auspices at Joachimsthal from ores won from the same deposits whence came the pitchblende that Madame Curie employed in all her early work. The Czechoslovakia industry, however, has never been large. England (Cornwall), Australia, and several European countries have contributed small amounts of radium ores, but never in significant quantities, and at present Canada is the only important source of radium outside of the Belgian-controlled African supply.

As reported in former volumes of Minerals Yearbook, an important discovery of pitchblende was made at Echo Bay, Great Bear Lake, Northwest Territory, by Gilbert LaBine late in 1930. In January 1933 Eldorado Gold Mines, Ltd., completed and placed in operation

its radium-refining plant at Port Hope, Ont. In summer the ores are transported to railhead at Waterways, northern Alberta, by water, a total distance of 1,400 miles. Some ore has been transported by airplane, air communication being maintained throughout the year. A little pitchblende has been found at other properties on Great Bear Lake, but no commercial production has been reported anywhere in that region except from LaBine Point, where underground development to a depth of 500 feet is reported to have disclosed highly satisfactory reserves of pitchblende accompanied by much silver. Shipments in 1936 exceeded those in the previous year, amounting to around 400 tons, and toward the end of the year the refinery treated an average of 20 tons of ore monthly, the normal yield being 1 gram of radium for each 10 tons of concentrated ore treated. Plant expansion was begun so as to increase capacity to 35 tons of ore per month, equivalent to a monthly recovery of over 3 grams of the element in the form of commercial salts. The uranium products, chiefly sodium uranate for the ceramic trade, which are jointly produced at the refinery, have found a ready market. Pitchblende occurrences have been reported in other parts of Canada, and active development has been maintained for several years by the Canada Radium Mines, Ltd., at its radium-bearing deposit at Cheddar, Haliburton County, Ontario, although no ore shipments have yet been reported from any of these localities. The total radium production of Canada previous to November 16, 1936, has been unofficially estimated at 1 ounce. Under the proposed production schedule it should amount to 2 ounces a year.

The price of radium, which in 1904 ranged from $10 to $25 a milligram, rose to $125 and even $135 during the World War and remained around $100 until it was cut to $70 in 1923, thereby causing production from American carnotite to cease abruptly. Soon after 1929 the collapse of world buying power resulted in a drop to $50 a milligram, the nominal quotation remaining at this level until early in 1936, when it was lowered to $40. During the last several years, sales of new radium actually have been made at $35 and more recently at $30; at forced sales, such as one required to settle a doctor's estate, radium has been bought for as low as $20 a milligram. The 1.7-mm platinum needle container costs $8, and its cost is added to the price of the radium unless the purchase amounts to 10 mg or more. Radon, or radium emanation, ordinarily is sold in the form of gold implants or "seeds", 5 to 7 mm long and 0.5 mm in diameter. The typical price of these implants in New York has been reduced from $4 to $2.50 per millicurie activity. Tubes having an initial activity of about 50 millicuries may be rented for about $25 to $35 per 48 hours; the radon content alone, exclusive of the gold tube, can be purchased outright for $50.

Imports of radium salts into the United States reached a maximum of 21.97 grams valued at $1,082,462 in 1934, dropped to 11.41 grams valued at $525,807 in 1935, and increased to 17.04 grams valued at $700,019 in 1936. Sporadic imports of "radioactive substitutes" are also reported in some years, reaching a maximum value of $2,913 in 1928. Imports of uranium oxide and salts, byproducts of radium, are summarized in this chapter in the section on uranium.

RARE EARTHS

Sparking flints for pocket cigarette lighters represent almost the only use of the rare earths that is even moderately well known, and even in this guise the identity of the active elements—chiefly cerium, lanthanum, neodymium, and praseodymium—is obscured by the practice of describing the pyrophoric alloy as "misch metal" or simply "sparking metal." For this purpose, as well as for flaming arc carbons and for preserving textiles, there is no need to separate individual members of this curiously homogeneous family, which includes 15 recognized elements (57 to 71). In making optical and art glass, however, such a separation is necessary; moreover, in making incandescent gas mantles a small amount of cerium oxide is extracted from the monazite along with the thoria, leaving a residue which represents the chief commercial source of the rare-earth group metals. Scandium (element 21) and yttrium (element 39) are not in the rare-earth group but are linked almost inseparably with that group by association in nature and general properties. Various practical applications have been found for many of these metals or their salts, but, even so, most of the rare earths must be listed as scientific curiosities. However, if more uses were developed, there should be no difficulty in obtaining adequate supplies, because they are actually fairly abundant in nature. Hopkins,[13] the discoverer of illinium and a recognized authority, declares that there is probably more cerium in the world than there is tin, mercury, antimony, silver, or gold, and that the probable supply of the group as a whole is greater than that of zinc, lead, or several other fairly common metals.

Sparking flints are fairly expensive, due to the high cost of adding iron to the rare-earth alloy as well as to the difficulty in fabricating them. Losses are such that virtually 1 pound of misch metal is required to make 1 pound of ferrocerium. Both misch metal and ferrocerium cost $6 to $10 a pound, depending upon quantity, but pure cerium metal is worth $25 a pound. Misch-metal prices are lower abroad than in this country. Almost the only rare-earth compounds for which general quotations are available are cerium hydrate and oxalate; at the close of 1936 the former was quoted at 65 cents and the latter at 28 cents a pound. Additional quotations, for small lots, furnished by A. D. Mackay (198 Broadway, New York, N. Y.), follow: Cerium oxide, technical, 75 cents a pound; cerium oxide, C. P., $3.50 a pound; cerium nitrate, $3.50 a pound; lanthanum metal (99 percent), $2.50 a gram; lanthanum nitrate, $20 a pound; lanthanum chloride, $25 a pound; neodymium oxalate (for ceramic use), $2.50 a pound; samarium nitrate, $2.50 a gram; samarium chloride, $2.50 a gram.

Misch metal is made in the United States by only one company, the American Treibach Co. (522 5th Ave., New York, N. Y.), which is affiliated with an Austrian company of similar name. Domestic consumption is of the order of 18,000 to 20,000 pounds a year, but could be increased quickly to several times this quantity. The company plant, at Niagara Falls, N. Y., now operates only 2 or 3 months each year, and salaries, power costs, and other overhead items have to be carried on a relatively small fraction of full-time capacity. If a customer could take as much as 100,000 pounds

[13] Hopkins, B. S., Europium, A Rare Member of the Rare-Earth Group: Amer. Electrochem. Soc., vol. 66, 1936, Preprint 66-16, pp. 167-168.

annually, a price of $2 a pound probably could be negotiated. So long as 99 percent of the material is made into ferrocerium for sparking flints for pocket cigar lighters and gas lighters such rapid expansion in consumption is not anticipated, but a good deal of experimenting is going on to develop other uses. Already a small outlet exists for fine steel making.

Misch metal can be made directly from monazite, but there is no occasion for using any virgin material as long as residues from gas-mantle manufacture continue to exist in great abundance. The making of gas mantles formerly was a comparatively larger industry in Austria, Germany, France, and a number of other European countries, as well as in the United States. At present, only 7,000,000 or 8,000,000 mantles are made in this country annually, compared with perhaps 60,000,000 immediately before the World War, and in Europe the output has diminished relatively even more. However, the accumulated residues at various plants here and abroad are said to be large enough to provide raw material for sparking flints at the present rate for about 75 years.

Imports of ferrocerium and other cerium alloys into the United States in 1936 amounted to only 22 pounds valued at $117; less than 1 pound of cerium metal (value only $19) was reported, and no imports of cerium ores (other than monazite) were recorded.

RHENIUM

Rhenium (element 75), discovered by the Noddacks in 1925 jointly with masurium, has been the subject of hundreds of scientific articles. Unlike masurium, rhenium seems available in fairly sizable quantities, for an ultrarare element, and it has been commercially available in pound lots since 1930. Progressive price reductions have stimulated a continuing interest, and an impressive list of patents indicates that the metal or its compounds may soon be commercially important. It has useful properties as a catalyzer and for thermo-elements, may be alloyed with rare metals, can be plated, and may have possibilities in incandescent-lamp technology. An important and unusual property is resistance to hydrochloric acid, a property that is retained in the plate. By 1935, production of rhenium had risen to a rate of 150 kg annually. The copper-bearing slates of Mansfield, Germany, contain 1 part in 5 million of rhenium, and the element is readily concentrated along with molybdenum and other rare elements in residues from the copper-extraction processes. If sufficient demand develops, other sources could be drawn upon to furnish as much as a ton or two a year. Perrhenate of potassium, the commercially available salt, is nominally worth about $1.75 a gram but can be bought in quantities at $1 a gram. Rhenium-metal powder is offered at as low as $1.25 to $1.50 a gram.[14]

RUBIDIUM

As indicated by its place in the periodic system, rubidium (element 37) is intermediate in its properties between caesium and potassium. Like caesium, it has been used in photoelectric cells. Rubidium salts are scientifically important as reagents in microchemistry and also have been advocated to modify the ghastly light from mercury

[14] Quotations furnished by Charles Hardy, Inc., New York, N. Y.

vapor lamps. Although no known mineral contains a large percentage of rubidium, the element frequently accompanies other alkali-group elements in nature and occurs in the water of many springs. Lepidolite is the present commercial source, except in the U. S. S. R. (Russia), where it is obtained along with caesium as a byproduct from the Solikamsk potash deposits (carnallite). The metal is worth about $6 a gram (in sealed tubes, in vacuo), and rubidium chloride, sulphate, or nitrate sells for 35 to 50 cents a gram, depending upon quantity. Fansteel Metallurgical Corporation and Calirare Chemical Corporation are domestic producers, and occasional importations are made. No data are available as to extent of domestic or foreign consumption, except that it is growing.

SCANDIUM

Although not a member of the rare-earth group, scandium (element 21) is present in many rare-earth minerals and resembles the rare-earth metals in certain analytical characteristics. There was no record of the metal having been isolated, even in a laboratory, until 1936, when German scientists were credited with having produced an appreciable quantity of metal of 94-percent purity.[15] No commercial uses for its salts are known. Scandium oxide (Sc_2O_3), a white powder resembling magnesia, can be bought for scientific or educational use at $7 a gram, while scandium nitrate costs even less, $3.50 a gram.[16]

SELENIUM

The progress of selenium (element 34), from a copper-refinery waste to a widely used commercial product has been followed in some detail in Bureau of Mines annual reviews. Production in 1936 increased, due to the revival of copper refining, and a surplus is indicated, allaying previous fears as to prospects of early shortage. However, the demand for selenium keeps growing. The pigments field seems to be especially promising, at the moment, and consumption of selenium in the manufacture of paint would doubtless increase even faster were it not that the selenium pigments also contain cadmium, the supply of which has become quite scanty.

Domestic sales of selenium reached a peak of 362,697 pounds in 1928, having grown rapidly and fairly steadily from 123,565 pounds in 1922. Domestic production declined sharply during the depression, but imports more than made up the difference. Moreover, although statistics are lacking, there is reason to believe that most of the domestic output during the last 5 years was retained for home consumption, whereas formerly substantial exports were made.

Selenium and selenium salts imported for consumption in the United States, 1932–36

Year	Pounds	Value	Year	Pounds	Value
1932	1,914	$2,240	1935	179,331	$322,332
1933	1,855	2,402	1936	122,806	215,835
1934	17,719	24,591			

[15] Metal Bulletin (London); No. 2106, July 14, 1936. p. 16.
[16] Quotations furnished by A. D. Mackay, New York, N. Y.

153336—37——50

Glassmaking was one of the first and is still a leading commercial outlet for selenium. Railway red signal glasses and other ruby glasses owe their color to selenium; but selenium is used more extensively in clear glass, having widely displaced manganese as "the glassmakers' soap" for neutralizing color. Long of scientific interest, though never of much significance as a sales outlet, are the several types of selenium cells that depend for their action upon selenium's peculiar property of increasing its electro-conductivity proportionately with the amount of light that falls upon it. By this means the lights of navigation buoys may be switched on at dusk and off again at dawn. The "optophone", which enables the blind to read ordinary type by ear, television operation, and sundry other devices [17] can be operated on this principle. Of importance, also, is the use of selenium in the manufacture of rubber, and selenium compounds are used extensively as insecticides and for treating bulbs before planting. Steel making has begun to take quite a substantial quantity of the metal in the form of ferroselenium, used to make stainless steel machineable. Many miscellaneous uses may be mentioned—"flameproofing" electric cables, biological chemistry, rectifiers for various electrical devices, catalysts for sundry reactions, in medicine, and for protecting metals from corrosion. Cadmium-red pigments (made from cadmium sulphide and selenium) already account for a substantial consumption of selenium.

The New York quotation for selenium (black, powdered, 99.5 percent pure), previously held nominally at $2 a pound, was quoted throughout 1936 at $1.75 to $2 a pound, according to quantity; ferroselenium (50 percent) was offered at $1.90 a pound of contained selenium. London quotations were strictly nominal at the beginning of 1936, eased to 7s. 6d. to 8s. ($1.88 to $2) in February as supplies began coming on the market again, and later found their level at 7s. ($1.75), ex-warehouse.

SODIUM

Common salt is the best-known sodium compound, but other sodium salts are highly important, and the metal itself (element 11), is far more important as regards tonnage made and used in the United States than are many better-known metals. Volume for volume, the world output of sodium exceeds that of nickel.[18] It is a silvery-white, soft, ductile, malleable metal that melts a trifle below the boiling point of water (at 97.6° C.); the specific gravity is 0.9712, not quite as heavy as water. Sodium is an excellent conductor of electricity and, properly protected, may be used for this purpose; but it tarnishes instantly in the air, and if moisture is present the outside film fails to protect the metal underneath. Because it is so reactive chemically, sodium is used almost exclusively as a reducing agent in organic-chemical industries. The metal is made in the United States by only one company, the Roessler & Hasslacher Chemical Co. (Inc.), a du Pont subsidiary, from caustic soda. A new process, which has reached the pilot-plant stage,[19] makes it by evaporating the mercury from sodium amalgam, which is an intermediate step in the Castner (electrolytic) process for making caustic soda.

Domestic production has been estimated at 8,000 to 10,000 tons annually for use mainly in making tetraethyl lead antiknock com-

[17] Wein, Samuel, Selenium Cells and How They Are Made: Progress Pub. Co., New York, 1919, 32 pp.
[18] Fink, C. G., Rare Metals and Minerals: Min. and Met., vol. 18, no. 361, 1937, p. 25.
[19] Fink, C. G., Work cited.

pounds and in making synthetic indigo, consumption being almost equally divided between these two industries. Probably 5,000 tons more a year are made as an intermediate product in the manufacture of sodium cyanamide, but this is a continuous process, and the metal never gets outside of the plant. It has been imported from Germany and Norway, but only intermittently.

Prices are largely contractual, much of the consumption being taken by concerns financially affiliated with the manufacturer. By January 1929 the price had gradually receded to 15 cents a pound for contract shipments, but small quantities cost a great deal more; orders for carload shipments might be accepted at 19 cents, although at least 75 cents a pound is asked by chemical-laboratory supply houses. A recent innovation is shipment in 40-ton tank cars. Previously the metal was always shipped in sealed drums, although it was made to flow around the plant in heated pipes.

STRONTIUM

Celestite and strontianite, the leading strontium minerals, are discussed in Minerals Yearbook in the chapter on Minor Nonmetals. Strontium (element 38) is a member of the alkaline-earth group; and, as might be expected from its position in the Periodic System, the metal has properties intermediate between those of barium and calcium. Inasmuch as it necessarily costs a great deal more than either of these sister metals, it has found almost no real commercial use. Although it was placed on the market in 1932 at $35 a pound and the price was later reduced to $20 a pound, the metal is virtually a laboratory curiosity. In 1936, however, mention was made of an alloy of magnesium plus 35 to 50 percent strontium as a "clean-up" agent for high-vacuum thermionic tubes.[20] Strontium salts, notably the nitrate, are used in the United States almost entirely in pyrotechnics, the chief outlet being the red flares used by railway companies and, more recently, on highways as warning signals. Strontium salts are used in sugar refining in Germany but not in the United States. Employment of strontium carbonate or other compounds in the steel industry has been investigated and appears to have some possibilities.

TANTALUM

Tantalum (element 73) is rarer than gold in the earth's crust. Discovered in 1802, it remained a laboratory curiosity for over a century. For a relatively few years, 1903 to 1911, it was used for incandescent electric-light bulb filaments, only to be displaced for this purpose by tungsten. By virtue of its electrolytic valve action, tantalum found another temporary place in industry for charging storage batteries in the early days of the radio, and before the use of tantalum chargers was diminished too greatly, the manufacture of tantalum was well begun in the United States. The American producer, Fansteel Metallurgical Corporation of North Chicago, Ill., rapidly created new uses, so that the metal is firmly established in a variety of practical applications. An outstanding characteristic of the metal is its remarkable resistance to acid corrosion. Being at the same time weldable and readily fabricated into almost any desired

[20] Fink, C. G., Rare Metals and Minerals: Min. and Met., vol. 18, no. 361, 1937, p. 24.

shape, it finds a substantial use in chemical process equipment and rayon spinnerets. In electronic tubes, tantalum is used for anodes or plates (in which, due to its gas absorptive capacity, it acts as its own getter and keeper), and tantalum support rods, getter cups, filaments, and grids are widely used. Due to its hardness and high melting point, tantalum carbide is a constituent of hard cutting-tool mixtures, notably Vascoloy-Ramet, and forms an important outlet for the metal. Other uses of tantalum have been mentioned in previous chapters of this series, and a résumé of late developments will be found in a paper by Balke,[21] the senior investigator in this field.

World supplies of tantalum ore have come almost exclusively from the remote Pilbarra district, Australia. Domestic ores have mostly carried too much columbium or have been otherwise too low-grade to be used for making tantalum metal, although exported for use in making alloys. Only small shipments have been made from Africa, South America, and British India. In 1936, the Soviet authorities announced that tantalum had been discovered in the ores of the Selianka titanium mine in quantities to justify the expectation that the U. S. S. R. (Russia) might soon become an exporter.

Detailed production figures for tantalite usually are not recorded, but a recent official British review [22] shows for 1935 an estimate of 16,800 pounds for the Western Australian output of tantalite (compared with 26,900 pounds in 1931). Nineteen thousand five hundred and seventy-two pounds of tantalite and columbite in Union of South Africa (a new producer), and 13,448 pounds of tantalite from South-West Africa, which came into commercial production in 1934 with 661 pounds. The South African material consists largely of tantalite and is obtained principally by the African Mining & Trust Co. (Pty.), Ltd., from weathered pegmatite in the Pietersburg district of the Transvaal.

Imports of tantalum ores into the United States in 1936 aggregated 20,758 pounds valued at $30,751, chiefly from Australia (14,246 pounds) but including 2,032 pounds from the Netherlands and 4,480 pounds from British East Africa.

Prices of tantalum have been stable in recent years, no attempt being made to keep pace with the fluctuations of the platinum market. For domestic consumption the base price for C. P. rod has remained for some time at $160.60 per kilogram and for sheet at $143 per kilogram. Discounts are allowed for volume business. London quotations remained nominal at £17 10s. to £18 10s a pound, equivalent to around $180 a kilogram.

TELLURIUM

Tellurium (element 52), like selenium, is a member of the sulphur family and, again like selenium, is a byproduct of electrolytic copper refining and can be recovered from other operations that treat sulphides. For example, at Odessa, U. S. S. R. (Russia), it occurs in flue dusts from a superphosphate plant. For many years no uses could be found for tellurium; in fact, it long remained an altogether obnoxious element that plagued the metallurgist in various ways. For a time it was thought to have a place in antiknock compounds for gasoline, but its nauseating odor, among other things, was objection-

[21] Balke, C. W., Columbium and Tantalum: Ind. and Eng. Chem. (Ind. Ed.), vol. 27, no. 10, 1935, pp. 1166–1169.

[22] Imperial Institute (London), Production, Utilisation, and Marketing of Columbite-Tantalite Minerals: Bull., vol. 34, no. 3, 1936, pp. 348–353.

able. The first use of real importance was the discovery by U. C. Tainton that tellurium was a most valuable reagent for purifying zinc solutions at western electrolytic plants, and by 1930 this provided an important outlet. The quantity required is 13 pounds per ton of zinc. By 1932, serious attention was being given to the successful use of tellurium as a rubber-compounding material. It increases the resistance of rubber to heat, seems to be effective in revitalizing old rubber, and improves ageing qualities. Gradually it came to be used commercially in rubber hose and cable coverings where great toughness and abrasion resistance are required. A new use in the rubber industry is in making latex. Another relatively large outlet for tellurium is for hardening lead. An alloy containing 0.06 percent tellurium was placed on the British market in the early 1930s; later it was made in the United States under the trade name "Teledium." Patent rights cover a wide range of lead-base alloys with varying quantities of tellurium and other metals, such as cadmium, antimony, and tin. The material is almost twice as strong as pure lead and has 8 to 12 times the corrosion resistance, although it can be worked very much like ordinary lead. Important, too, may be the use of tellurium in the steel industry. Although its use in steel is just beginning, laboratory tests seem to indicate that tellurium is better than selenium because it is more easily soluble in the steel. Difficulty has been experienced, however, in getting a suitable low-grade alloy. A ferrotellurium containing even as low as 9 percent does not seem to work well, and a 2-percent alloy is desired. The use of tellurium ("metalloid of the selenium-tellurium group") is covered by Carpenter Steel Co. patents for free-machining steels (U. S. Patents 2009713–16). Colloidal tellurium has been introduced in medicine, and the element and its compounds are listed as bactericides. In conjunction with ferric chloride, telluric anhydride has been used in light-sensitive photographic preparations.

Three American companies reported production of tellurium in 1936, and a fourth reported sales from stock. American tellurium is exported to Europe, although Germany, Sweden, and possibly other countries likewise are recovering tellurium. In Canada, tellurium is now being produced at Copper Cliff, Ontario, and at Montreal East, Quebec, the total output amounting to 52,724 pounds valued at $93,322 in 1936, compared with 16,425 pounds valued at $32,850 in 1935.

With the upturn in copper refining there is no early prospect of a shortage of tellurium, but in 1935 inquiry was made as to additional supplies of metallurgical residues and even as to deposits of tellurium-bearing ores. An occurrence of native tellurium associated with more or less gold has been investigated in Catron County, N. Mex., which seems to be the only domestic occurrence of even potential importance.

The New York quotations for tellurium have continued nominally unchanged for several years at $2 a pound. In London, trade journals were quoting the metal at 6s. 6d. to 7s. 6d. ($1.60 to $1.85) in January 1936. Later this quotation was narrowed to 7s. ($1.75).

Tellurium sold by producers in the United States, 1932–36, in pounds

1932	1, 567	1935	22, 610
1933	11, 980	1936	25, 453
1934	21, 027		

THALLIUM

A bluish-white, soft metal, thallium (element 81) resembles lead not only in its physical properties but also, to a considerable extent, in its chemical properties, although in the latter respect it somewhat resembles potassium. The metal itself is obtainable without much difficulty, but it is used only in quite small amounts for special alloys; lead-thallium alloys are highly resistant to corrosion. Even in its compounds thallium finds no very large sale, although significant quantities, chiefly as sulphate, are used in rat poisons and for ground-squirrel and rodent control generally. It also has been recommended for killing ants and as a fungicide and insecticide. Small quantities, a few hundred pounds annually, have long been used in optical glass, photoelectric cells, and medicine, and later developments are moth-proofing agents and fabric-finishing materials. A variety of other uses, including antiknock motor fuel, have been suggested, many of them having been patented, but none of them seem to have reached the commercial stage. Formerly, thallium was used rather widely in depilatories, but inasmuch as it is a cumulative poison of high toxicity this use has been discouraged. Recently, however, experiments have been made in the U. S. S. R. (Russia) with a view to controlling the moulting of sheep, particularly of merinos that do not moult naturally; promising results were obtained, although many of the sheep died, and more work has to be done.

Thallium is not a common element, but it is present in a large number of minerals and moderately substantial quantities may be recovered from the flue dusts from lead furnaces and pyrites burners. Partly because the demand is rather small there is only one domestic producer, the American Smelting & Refining Co.; but additional quantities of thallium sulphate and a little thallium acetate have been imported from Germany, Poland, and Belgium. Prices since the World War have ranged from above $20 to a minimum of about $5 a pound. The price of the metal in small lots is $15 a pound.

THORIUM (AND MESOTHORIUM)

Thorium (element 90), like uranium, is the source of a series of radioactive elements of lower atomic weight. In the process of disintegrating to inert lead, the thorium group emits radiations similar to but not always identical with those from radium. Mesothorium, the immediate disintegration product of thorium, is chemically identical with radium. Its preparations emit the three types of rays characteristic of radium, but it is much shorter lived. Separated from thorium, a given specimen of mesothorium decays to half value in 6.7 years, to one-fourth of its original value in another 6.7 years, to only one-eighth of its original value in a third period of 6.7 years, and so on. The half-life period of radium, on the other hand, is 1,690 years. Mesothorium can be substituted for radium for certain therapeutic purposes but is possibly more important commercially in radioactive luminous materials. Over a period of 15 years, the brightness of luminous materials activated with mesothorium is in no way inferior to that of those made luminous by radium.[23] Formerly radium cost a great deal more than mesothorium, but as radium has

[23] Schlundt, Herman, Mesothorium: Foote-Prints, vol. 4, no. 1, 1931, pp. 3-17.

become cheaper, mesothorium, remaining at about a constant price, is the more costly of the two. In 1936, the American Treibach Co. (522 Fifth Ave., New York, N. Y.) imported 45 to 50 mg of mesothorium from Austria. Domestic requirements may increase, but at present more mesothorium is used abroad than in the United States. In England and France, for example, luminous telephone dials are employed, activated with mesothorium.

The main use of thorium has been in incandescent gas mantles, for which purpose thorium nitrate is extracted from monazite sand along with a small amount of cerium. The fabric is saturated with a mixture of "rare-earth nitrates", accompanied by beryllium nitrate and magnesium nitrate, and then burned. Mesothorium is a byproduct of the production of thorium nitrate, though not always recovered. Thorium compounds are used in X-ray work, and thoria catalysts have been employed for certain reactions. Thorium oxide is a super-refractory and has been used recently to an increasing extent in making laboratory crucibles that can be employed in melting pure metals at temperatures up to 2,300° C. Sintered thorium metal was put on the market by Westinghouse Lamp Co. laboratories in 1930 in various shapes and sizes at $75 a pound and more. Thorium has been used in filaments of tungsten lamps to prevent embrittlement; for this purpose, however, as well as for electron-discharge devices and other electron-emitting uses, the element is not introduced in the form of the metal. Suggested uses for the metal are in photoelectric cells, glow-tube electrodes, and X-ray targets.

Thorium is a soft, malleable metal, stable in the atmosphere and otherwise easily worked and handled. In addition to its high thermionic emissivity, consideration may be given to the fact that its oxide is the most refractory oxide known. It is not destined to be a cheap metal, but neither is it unduly costly now that the price of monazite has fallen as a result of the diminished demand from the gas-mantle industry for thorium nitrate. This combination of circumstances would seem to afford a sound basis for active research into new fields of use.

Thorium nitrate has recently been quoted by the Oil, Paint, and Drug Reporter at $2.20 a pound. Monazite, the ore of thorium, was formerly quoted at $60 a ton basis 6 percent ThO_2, but more recently an 8-percent grade has been listed at $60 to $75 a ton. Mesothorium costs about $35 a milligram.

The imports of thorium nitrate and other thorium compounds in 1936 amounted to only 4,411 pounds valued at $5,578. In 1921 they were 44,554 pounds valued at $89,672, and the maximum was 144,413 pounds valued at $309,760 in 1914 (fiscal year).

TITANIUM

About two and a half times as plentiful in the earth's crust as carbon, titanium (element 22) is a constituent of almost all common rocks. Ilmenite and rutile, however, are the only minerals that have been mined at all extensively as titanium ores, and commercial deposits of these minerals are relatively few. Fortunately, ilmenite deposits in British India, Norway, and the United States are large and easily worked, so that the supply is abundant and cheap. Titanium metal has virtually no commercial uses, though it can be purchased at about $6 a pound. Its alloys, particularly ferro-carbon-titanium, which is

used in the steel industry, are important and are consumed in rapidly growing quantities not only in steel making but also for use in making iron castings and various nonferrous alloys. Formerly employed almost exclusively as a deoxidizer, it has recently begun to be important in the manufacture of rustless steels to inhibit intergranular corrosion. Titanite, an aluminum-manganese-titanium alloy, takes a high polish that resists corrosion. Most important is the production of titanium pigments, which has grown at an astonishing rate in less than a decade from an insignificant industry requiring only 2,000 or 3,000 tons of ilmenite to a large business whose purchases of this raw material now exceed 100,000 tons a year. The consumption of rutile likewise has increased sharply. Scarcely 5 years ago this naturally occurring dioxide of titanium was used to only a small extent in the ceramic industry and had almost no other important applications until it began to be demanded in really large quantities for the manufacture of welding rods. Meanwhile, its ceramic uses have shown healthy growth. Titanium dioxide is used in ceramic glasses, in "topaz" yellow glassware, and to increase fluidity of acid-resisting enamels. For the acid-stable enamels as much as 8 percent TiO_2 is added, the yellow coloration being suppressed by a 2-percent addition of sodium fluosilicate.[24] A German patent (622346, I. G. Farbenindustrie) describes the production of a glass containing 20 to 48 percent of TiO_2 and 20 to 35 percent alkali (remainder acid oxides) made colorless by nitrate additions to the batch, which is melted slightly above 1,300° C.

Miscellaneous uses of titanium compounds are for smoke screens, "sky-writing", and pyrotechnics (tetrachloride); for arc-light electrodes; in dyeing and tanning; as abrasives (carbide); and in medicinal and toilet preparations. In addition to their use in paints and lacquers, titanium pigments are being used to an increasing extent in paper, linoleum, for delustering rayon, in printing ink, white rubber, plastics, cosmetics, soaps, and in shoe polishes and various leather and synthetic finishes.

Summarizing 1936 developments, E. L. Lasier, vice president of the Titanium Alloy Manufacturing Co., in a letter to the author, comments upon the greatly increased use of iron-titanium alloys (both high and medium carbon) in the steel industry for deep-stamping and automobile body stock. In the production of intermediate manganese steels, ferro-carbon-titanium is displacing more expensive alloys, notably nickel and vanadium. Other important developments have been the work on temper-hardening of copper-titanium alloys, the use of titanium in gray cast iron and in aluminum (through the use of a master alumino-titanium alloy), and a prospect of employing the element to assist in age-hardening of chrome-nickel steels.

The American Rutile Co., leading producer of rutile, formerly operated its milling plant at Roseland, Nelson County, Va., only 2 or 3 months at a time, but in 1935 it built a new, modern mill which was operated almost continuously in 1936 and may be enlarged to a capacity of 500 tons of crude ore a day. No production figures are released by the company, but private estimates place the present output as high as 2,000 short tons of rutile a year. Rutile or brookite was produced in Hot Springs County, Ark., in 1936 by the Titanium Corporation. It has been difficult to recover high-grade rutile in

[24] Vielhaber, Titanium Dioxide: Emailwaren Ind., vol. 12, no. 52, 1935, pp. 419–420; Ceram. Abs., vol. 15, no. 8, 1936, p. 231.

commercial quantities from this area, but the ore-testing section of the Bureau of Mines succeeded in making good-grade concentrates from Arkansas rutile by flotation.

Ilmenite produced in this country is largely a byproduct of rutile mining by the American Rutile Co., or a joint product of apatite by the Southern Mineral Products Co., Piney River, Va., which is not far from the Roseland operation although in Amherst County. In 1936 the latter company sold its adjoining chemical plant, used for making calcium monophosphate and titanium pigments, to the Virginia Chemical Co., a newly created subsidiary of the International Printing Ink Co. The original company, however, continued its mining activities and, in addition to supplying apatite and ilmenite concentrates to the new concern, shipped ilmenite concentrate to the ferro-alloy works of the parent company, the Vanadium Corporation of America, at Niagara Falls, N. Y.

Domestic production statistics cannot be published without disclosing the operations of individual companies, but the import statistics serve to show the rapid growth in domestic consumption of both ilmenite and rutile. For several years British India supplied all the imports of ilmenite and is still the principal supplier, but Norway contributed 22,472 long tons in 1935 and 32,126 tons in 1936 despite rumors to the effect that the Norwegian ore is not well liked in the United States and accordingly will henceforth be sold mostly in Europe. Of possible significance, too, is the average import valuation in 1936 of $6.22 a long ton for imports from Norway, compared with $5.32 for those from British India and only $4.30 for the 8,600 long tons credited to the United Kingdom (obviously a reshipment).

Titanium ores imported for consumption in the United States, 1932–36

Year	Ilmenite		Rutile	
	Long tons	Value	Pounds	Value
1932	33,491	$231,652	176,395	$4,508
1933	38,610	196,211	157,658	3,737
1934	71,710	356,208	309,221	7,350
1935	115,871	636,293	423,577	13,124
1936	127,491	687,822	1,019,449	38,552

Data on imports by customs districts show that all Norwegian ilmenite is imported at New York, whereas Indian-ore imports are divided between Maryland and Philadelphia. In former years there were entries at New Orleans for shipment to St. Louis, but this movement ceased before 1936.

Rutile is now imported chiefly from Brazil, although small quantities were received in 1936 also from Canada (14,000 pounds valued at $1,128) and Australia (10,000 pounds valued at $674). About 75 percent of the rutile arrives at New York; the rest goes to Philadelphia, except that in 1936 a fair-sized shipment was made to Virginia.

Imports of ferrotitanium and other titanium alloys are quite small, amounting in 1936 to 2,240 pounds valued at $303 from the United Kingdom.

Among foreign developments may be mentioned further prospecting at the Selianka mine in the Chelyabinsk oblast, U. S. S. R. (Russia), and a substantial increase of exports of "amang", a product of the

Straits Settlement containing only 0.15 percent tin and valuable chiefly for its titanium content. In Norway production has been increased so that around 60,000 tons annually can be handled, and a new aerial tram was built in 1936, according to a British report. At one time Ceylon produced monazite from its black-sand deposits, and recently the Ceylon Bureau of Industry and Commerce was reported to be giving attention to possible exploitation of these areas for ilmenite and zircon. The largest known black-sand deposit on the island is on the east coast about 35 miles north of Tricomalee and extends 4 miles along the shore. Brazil's rutile deposits are in the States of Goyaz and Minas Geraes. The ores from the latter State ordinarily contain ilmenite and, accordingly, analyze only 70 to 85 percent TiO_2, but those from Goyaz run up to 95 percent or more. In 1936 quotations f. o. b. Rio de Janeiro, for export to United States and England, were as low as $20 a metric ton. Ilmenite occurs in beach-sand deposits on the coast of Espiritu Santo, accompanied by monazite, zircon, garnet, and magnetite. The entire production of ilmenite in India comes from beach deposits leased from the Government of Travancore State. Until a few years ago two British firms, the Travancore Minerals Co., Ltd., and Hopkins & Williams, Ltd., were the only producers, but in 1932 F. X. Pereira & Sons entered the field, and, even more recently, M. E. Masillamany, B. A., Travancore, is rumored to have begun exporting, while a group called the Malabar Mining Co., Neyyattinkara, was said to be negotiating for a mining lease.

World production of titanium minerals, 1932–36, in metric tons

[Compiled by M. T. Latus]

Mineral and country	1932	1933	1934	1935	1936
Ilmenite:					
Australia: Tasmania		559			(1)
Canada (Quebec)			1,835	2,076	2,328
Egypt	487		164	183	(1)
French West Africa (Senegal)[2]		370	490	1,250	(1)
India, British (Travancore)	50,856	53,830	76,858	129,090	(1)
Malay States, Federated [3]	(1)	204	51	2,540	(1)
Norway	13,481	23,213	26,306	37,984	(1)
Portugal	766	645	434	264	(1)
United States	(3)	(3)	(3)	(3)	(3)
Rutile:					
Brazil [2]	35	96	116	287	(1)
Cameroun, French				45	(1)
Norway	[4] 30	[4] 56	247	[4] 124	(1)
United States	(3)	(3)	(3)	(3)	(3)

1 Data not available.
2 Exports.
3 Bureau of Mines not at liberty to publish figures.
4 Concentrates.

Ferro-carbon-titanium, the leading tonnage alloy, was quoted in 1936 at $137.50 per ton, f. o. b. Niagara Falls, N. Y., for the 7- to 8-percent-carbon product. Rutile concentrates, guaranteed minimum 94 percent, continued to be quoted at 10 cents a pound, although less than $100 a ton could be obtained for lower-grade ore that required further cleaning before it could be sold for ceramic uses. The price of artificially produced titanium dioxide of pigment grade was reduced from 17 to 16 cents a pound on November 4, 1936. This quotation is for carload lots and for packing in paper bags; for material packed in barrels the quotation is 16¼ cents.

URANIUM

According to most chemists, uranium (element 92) is the heaviest element that is ever likely to be found in our universe. It spontaneously decomposes to form at least two families of radioactive elements (of progressively diminishing atomic weight), of which radium is the best-known and most important commercially. The ratio of radium to uranium in pitchblende and other ores never exceeds 1 part in 3.4 million, and unless the radium-bearing minerals are old enough to have reached equilibrium, the proportion is even less. It follows that all radium-recovery operations release at some time a fairly large quantity of uranium compounds. Occasionally there has been a surplus of such compounds, although, conversely, low-grade ores also have been utilized mainly as a source of uranium. The free element can be made without excessive difficulty in the form of black powder, but it has no recognized uses. Ferro-uranium has been advocated for use in making steel, and for a brief period after 1918 it was employed in a small way as a substitute for ferrovanadium; however, the consensus of opinion among steel metallurgists now seems to be that adding uranium to steel affords no improvement that cannot be obtained more economically by other means. Uranium acetate and other compounds are valuable analytical laboratory reagents, and uranium salts have been employed to some extent in photography, dye making, and medicine. The chief use of uranium, however, is in ceramic glazes and glass manufacture to produce a characteristic yellow colorization, for which purpose sodium uranate (Na_2UO_4) is the usual commercial vehicle. This salt is either yellow or orange, contains 83 percent U_3O_8, and is worth about $1.25 a pound.

The Vitro Manufacturing Co., Pittsburgh, Pa., and the Shattuck Chemical Co., of Denver, Colo., produce uranium compounds in this country from domestic carnotite ore. A substantial part of the domestic requirements, however, is satisfied by supplies from foreign sources. Imports of uranium oxide and salts were relatively small until about 1926, rose to 272,913 pounds valued at $344,548 in 1929, and then, after declining during the depression years, jumped to 296,389 pounds valued at $292,207 in 1935. In 1936 they rose further to 341,040 pounds valued at $374,110; most of it was from Belgium, as in former years, although 62,567 pounds valued at $61,088 came from the newly created Canadian source.

VIRGINIUM

The blank space in the periodic chart for "eka-caesium" (element 87) was filled, it was announced, in 1930 when Dr. Fred Allison and his coworkers at Alabama Polytechnic Institute declared that they had discovered this long-sought substance by their magneto-optic analysis of pollucite and lepidolite. They named it virginium (Vi). The validity of this discovery was challenged by Prof. Jacob Papish and Eugene Waiver, of Cornell University, who announced their own discovery of this element by X-ray analysis of a calcite crystal. Later, doubt arose in the Cornell laboratories as to whether the newly noted spectral lines exhibited by this crystal actually were due to this elusive element. In many minds, therefore, there is still a question as to whether element 87 has been discovered. The evidence certainly tends to show that this element is not present in perceptible

proportions in many substances on this earth. Even Dr. Allison found that the concentration of virginium in the substances he investigated was very low, ranging from a few parts in a million million to a maximum of 1 part in 10 billion. Notwithstanding its high atomic weight and its close proximity to radium in the periodic table, it appears likely that virginium is not radioactive.

YTTRIUM

Yttria was discovered by the distinguished Finnish scientist, Jacob Gadolin, in 1794, and half a century elapsed before Mosander showed that, instead of being a simple oxide, it contained at least three elements. Whereas the yttrium family comprises two subgroups of rare-earth metals, yttrium (element 39), according to modern terminology, paradoxically is not a member of the rare-earth group, although it would seem to belong there by virtue of almost every criterion except its order in the periodic arrangement of the elements according to their progressively increasing atomic weights. In common with rare earths, yttrium is commercially obtainable in gas-mantle residues, and yttrium nitrate can be extracted from monazite sands by nitric acid. However, monazite rarely contains as much as 5 percent yttria, and the Government mineralogist of Western Australia has reported that in 1920 as much as 1 ton of gadolinite carrying 45 percent yttrium earths and 4 percent cerium earths was exported from Cooglegong, and at various times some hundreds of pounds of yttrotantalite, tanteuxenite, and xenotime—all high-yttrium minerals—have been collected for experimental purposes. Yttria has been used in gas mantles and in arc-light electrodes, especially those for ultraviolet radiation. Several yttrium salts are employed in analytical chemistry and may have use as insecticides or for mothproofing (see United States Patent 1739840). The free element is produced without undue difficulty as a coarse gray powder and has been used in patented lamp alloys that exhibit selective radiation at luminous temperatures. Yttrium nitrate costs 20 cents a gram and the metal $10 a gram, in small quantities.[25]

ZIRCONIUM

During the last few years the consumption of zirconium compounds has grown rapidly. The element (40 in the periodic table), is marketed in metallic form, although not in large quantities. The powdered metal is used to a limited extent in flashlight mixtures and in ammunition primers; and pure, wrought, crystalline-metal wire is used in radio tubes and sheet metal in spinneret cups for rayon manufacture. Zirconium-silicon and zirconium-ferrosilicon are developing a gradually growing use in steel making, as superscavengers of oxygen and sulphur and for controlling grain size. The specific gravity of the metal is 6.52. Hence, it is a trifle lighter than antimony and considerably lighter than steel. Its melting point, 2,130° C., is higher even than that of platinum. Zirconium is a very reactive metal, although it is resistant to hydrochloric acid and nitric acid does not affect it at all. It combines with all except the rare gases, the compounds thus formed tending to migrate toward the inside of a filament, leaving a fresh surface exposed—an important factor in

[25] Quotations furnished by A. D. Mackay, New York, N. Y.

certain classes of high-temperature closed-tube applications. The extraordinary increase in industrial importance of zirconium, however, is based upon the employment of its compounds in enamels and for electrodes or welding-rod coatings. Properly purified zirconium oxide is quite as good an opacifier as tin oxide in virtually all types of commercial vitreous enamels and costs much less. Another important development is the fast-growing use of a new type of glaze, in which zirconium is introduced not only in the opacifier or pigment of the glaze but also to some extent into the frit or glass. It is claimed that this type of glaze is superior to other glazes in durability, stability of color, and economy. The indicated market is large, and sales of zirconium products for this purpose almost tripled in 1936. A particularly interesting development is the new electrical heating element for stoves and furnaces made with granular and milled zircon. Zirconia refractories are of some importance, and zirconium compounds have many minor uses, some of which, still in the development stage, may contribute further to the rapid increase in demand for this relatively new metal in the industrial field.

Zircon, the silicate ore of zirconium, has been produced sporadically in North Carolina and subsequently in Florida, chiefly as a by-product of the short-lived monazite industries of the South; but no domestic production of zirconium ores has been reported since 1927, when operations at Pablo Beach, Fla., yielded 3,646 short tons. Zircon and cyrtolite have been reported in Canadian pegmatites, but nowhere in North America has there been any substantial production of these ores. For many years Brazil was almost the only source of world supply, producing not only zircon from beach sands but also baddeleyite, a natural oxide. British India is another large producer, zircon accompanying the monazite and ilmenite in the Travancore beach sands, the proportions varying considerably, however, at different points along the coast. Among the newer producers is Australia, where zircon likewise is recovered from beach sands that extend discontinuously along the coast of New South Wales from Fort MacQuarie to the Queensland border. One of the operations in this area is financed by the Titanium Alloy Manufacturing Co., of Niagara Falls, N. Y.

Until about a dozen years ago, world consumption of zirconium ores probably never exceeded a very few hundred tons in any single year, and it was not until about 2 or 3 years ago that domestic needs exceeded about 500 tons annually. An importation of over 1,500 short tons of zirconium ore was reported for the period July to December, 1918, but apparently much of this went into stock, as did also some portion of the domestic production from Florida beach sands. Eventually these stocks were disposed of, and since about 1928 the import statistics doubtless indicate rather closely the quantities available for consumption in this country. In 1929 the imports jumped to 1,345 short tons, increasing to 1,519 tons in 1930 but dropping to 562 tons in 1931. Later figures are given in the following table, which shows also recent rather small importations of zirconium metal powder, ferro zirconium, and other alloys.

Zirconium ores and alloys imported for consumption in the United States, 1932–36

Year	Zirconium ores		Ferrozirconium, zirconium, and zirconium ferrosilicon	
	Pounds	Value	Pounds	Value
1932	26,506	$437		
1933	568,581	5,306		
1934	1,706,192	27,197	112,000	$7,605
1935	5,756,726	76,923	26,166	2,079
1936	11,565,340	115,180	86,872	4,797

Until 1935 ore was imported almost exclusively from Brazil, but increasing quantities have come from other sources. In 1936 British India supplied 1,422 tons, valued at $29.35 per ton; Australia, 3,603 tons valued at $15.35 per ton; and Brazil, 751 tons, valued at $23.95 per ton. In addition, Canada furnished 6 tons and the United Kingdom 1 ton. A considerable portion of the imports from Australia comprised sands containing not more than about 60 percent zircon mixed with rutile and other minerals. Inasmuch as most of this material and possibly some portion of imports from other countries during the last 2 years has gone into stocks, the increase in the consumption of zircon, large though it is, is not so large as the remarkable increase in imports might indicate.

The Foote Mineral Co., Philadelphia, Pa., has recently quoted zirconium-metal powder (98 percent) at $6.35 per pound in ton lots, crude zirconium oxide (80 percent) lump at $80 per ton in carlots, and zirconium concentrates (62 percent) at $46 per ton in carlots. Zirconium-metal sheet sells for about 30 cents a gram.

PART III. NONMETALS

COAL

SUMMARY OUTLINE

PART 1. *Bituminous coal, by F. G. Tryon, L. Mann, and W. H. Young*

PART 2. *Pennsylvania anthracite, by F. G. Tryon, H. L. Bennit, and J. R. Bradley*

Part 1.—BITUMINOUS COAL[1]

By F. G. Tryon, L. Mann, and W. H. Young

THE BITUMINOUS INDUSTRY IN 1936

In the bituminous-coal industry the year 1936 was one of expanding production but of intensified competition. Output increased to the highest level touched since 1930. Prices, however, declined slightly, or at best in most areas maintained the levels of 1935, although a 10-percent increase in wage rates had become effective in October of that year.

Final detailed reports of operation in 1936 will not be available for several months because of the time required to canvass the 6,500 commercial producers. Meanwhile, the broader trends are shown by preliminary or sample data presented in tables 1 to 7. The current

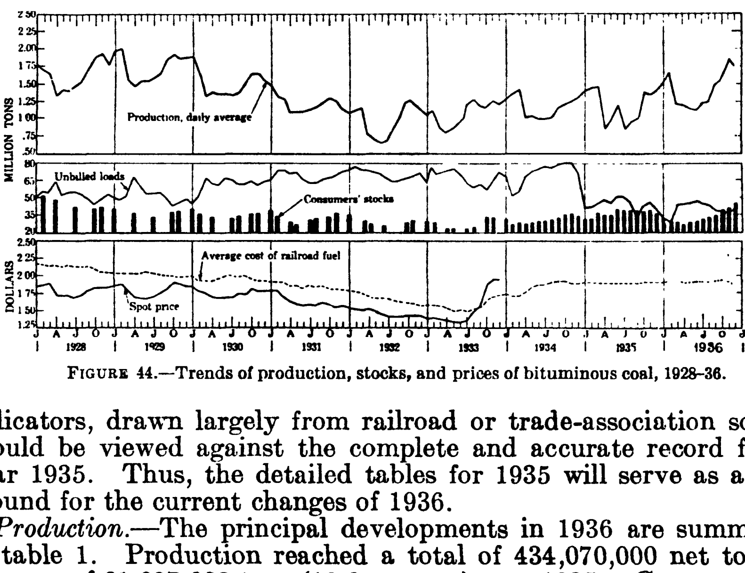


FIGURE 44.—Trends of production, stocks, and prices of bituminous coal, 1928–36.

indicators, drawn largely from railroad or trade-association sources, should be viewed against the complete and accurate record for the year 1935. Thus, the detailed tables for 1935 will serve as a background for the current changes of 1936.

Production.—The principal developments in 1936 are summarized in table 1. Production reached a total of 434,070,000 net tons, an increase of 61,697,000 tons (16.6 percent) over 1935. Compared with 1932—the trough of the great depression—the record for 1936 represents an increase of 124,000,000 tons. (See figs. 44, 45, and 47.)

Exports and imports.—Exports increased, but in a smaller ratio than production. Shipments to Canada and Mexico were 9,911,987 net tons—a gain of 9.6 percent. Exports overseas and to all other destinations increased 6.4 percent.[2] (See fig. 54.)

Imports also increased, but remained negligible in proportion to the domestic supply.

Changes in stocks.—Part of the increased demand in 1936 consisted of purchases for storage. Stocks in the hands of industrial consumers

[1] Data for 1936 are preliminary; detailed statistics with final revisions will be released later. Data for 1935 are final.

[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

and retail coalyards increased from 37,017,000 tons at the beginning of the year to 43,499,000 at the end. The net addition to consumers' stocks was thus 6,482,000 tons during the year—an increase of 17.5 percent. In some instances, the flow into storage went to increase reserves in anticipation of a possible stoppage of production when the wage agreements should expire March 31, 1937. In general, however, the additions to stock piles were no more than were necessary to keep pace with the increase in consumption, and the reserve on hand January 1, 1937, was enough for 31.7 days compared with 30.2 days the year before. In terms of current requirements, the reserves at the beginning of 1937 were therefore far below those built up on some previous occasions, such as April 1, 1927, when a 53-day supply was in storage.

Stocks on the upper Lake docks increased by 12.1 percent during the year, or slightly less than the indicated increase in national consumption.

Coal in cars unbilled at the mines or in classification yards increased 2.2 percent in tonnage during the year but decreased in relation to demand. At the beginning of the year the unbilled loads were equivalent to 0.9 day production and at the end of the year to 0.8 day.

Consumption.—Allowing for foreign trade and for changes in consumers' stocks, the total consumption in the United States was 417,202,600 tons, an increase of 15.8 percent over the year 1935. The increase was widely distributed and was shared by nearly all of the major classes of consumers. (See table 5 and fig. 46.) By far the largest increase centered around the revival of activity in steel. Consumption of gas and steam coal at steel works and rolling mills increased 14.7 percent over 1935. Consumption in furnace byproduct coke ovens increased 38.1 percent and in beehive coke ovens 96.9 percent. The total increase in the consumption of the iron and steel industry was approximately 16,000,000 tons.

Gains in other channels of consumption, though less striking, were real. The demand for locomotive fuel increased 13.2 percent. Rapid expansion in sales of electric power, coinciding with the low heads of water at some hydroelectric plants affected by the drought, brought an increase of 20.6 percent in the coal requirements of the electric power utilities.

Consumption at cement mills advanced 38.3 percent and at general manufacturing plants 18.6 percent. Even the trade in coal for ships' bunkers, which had largely passed to fuel oil, increased 3.4 percent during 1936.

Price trends.—Prices stiffened in the cold weather of January and February but declined over the rest of the year. Trade-journal quotations on 61 grades of coal averaged $2.26 a ton, f. o. b. mines, in February 1936 as against $2.04 in the same month of the year before. Thereafter in each month from April to December 1936 the average quotations on the same coals ran somewhat below those of the corresponding month of 1935. The average of the quotations for the entire year 1936 is $1.99 a ton, as against $2.04 in 1935—a decrease of 5 cents.

Other barometers likewise point to stationary or often declining prices. The average cost of railroad fuel, excluding direct freight charges, was $1.89 a ton in 1936—exactly the same figure as the year before. The average price paid by Canadian buyers for American

153336—37——51

coal, f. o. b. mines in the States, declined 6 cents a ton.[3] Cost of coking coal delivered at merchant byproduct ovens declined 13 cents a ton. Costs of bunker coal delivered to vessels in foreign trade declined 6 cents a ton. The average value of all coal exported from the United States, reckoned at the port of loading, increased over 1935, but this increase was only 6 mills per ton.

The only barometer pointing definitely to an increase was the average retail price in 38 of the principal cities. This price advanced 10 cents a ton (1.2 percent) from an average of about $8.30 a ton in 1935 to about $8.40 in 1936. The indicated rise, however, was confined to the period of exceptionally cold weather in the first portion of the year.

Freight rates.—The emergency surcharges in railroad freight rates, averaging about 12 cents a ton, which had been authorized April 18, 1935, continued in effect until June 30, 1936. Effective July 1, they were reduced to an average of approximately 9 cents a ton and remained at that level to December 31, 1936, at which time they were discontinued.

The average freight charge per net ton of revenue bituminous coal was $2.25 in 1936, as against $2.24 in 1935. It is evident, therefore, that in 1936, as in earlier years, the average freight charge was considerably greater than the average price of coal, f. o. b. mines (table 7).

Increased mechanization.—A marked increase in the installation of mechanical loading devices is indicated by manufacturers' reports of sales made in 1936 (tables 28 and 29). Sales of mobile loading machines and of conveyors established new records. Returns from 28 manufacturers show sales of 344 mobile loading machines as against 115 in 1935—an increase of 199.1 percent. Sales of conveyors, including those equipped with duckbills, totaled 660 units—an increase of 115 percent. Statistics of the tonnage loaded by machine are not yet available, but it is clear that the final returns will show a large increase over the 47,177,000 tons mechanically loaded in 1935.[4]

Growth of stripping.—Further increase in the stripping of coal occurred in 1936. Six new stripping operations were begun or completed during the year. In Illinois the tonnage produced by stripping increased 21.3 percent, while the tonnage from shaft mines increased only 13 percent. It is clear that the final returns for the country as a whole will show an advance over the record of 1935, when 23,647,292 tons of bituminous coal and lignite were mined by stripping in the United States.

Mechanical cleaning.—Parallel activity marked mechanical cleaning by wet and pneumatic methods in 1936. A total of 36 installations was made during the year, with an annual capacity conservatively estimated at 8,000,000 tons of cleaned coal. Despite the increase in fixed charges, and often in labor, that it entails, mechanical cleaning is strengthening the industry's position in competition with other fuels.

Trend of employment.—The average number of men employed at bituminous-coal mines in 1935 was 462,403. Information so far available points to a slight increase in the number employed during 1936. The monthly employment returns of the Bureau of Labor Statistics,

[3] Computed by J. R. Bradley from the Quarterly Trade Returns of the Canadian Government. The value of imports as recorded in the Canadian customs statistics represents the fair market price in the country of origin and excludes transportation costs.

[4] See chapter on Progress of Mine Mechanization.

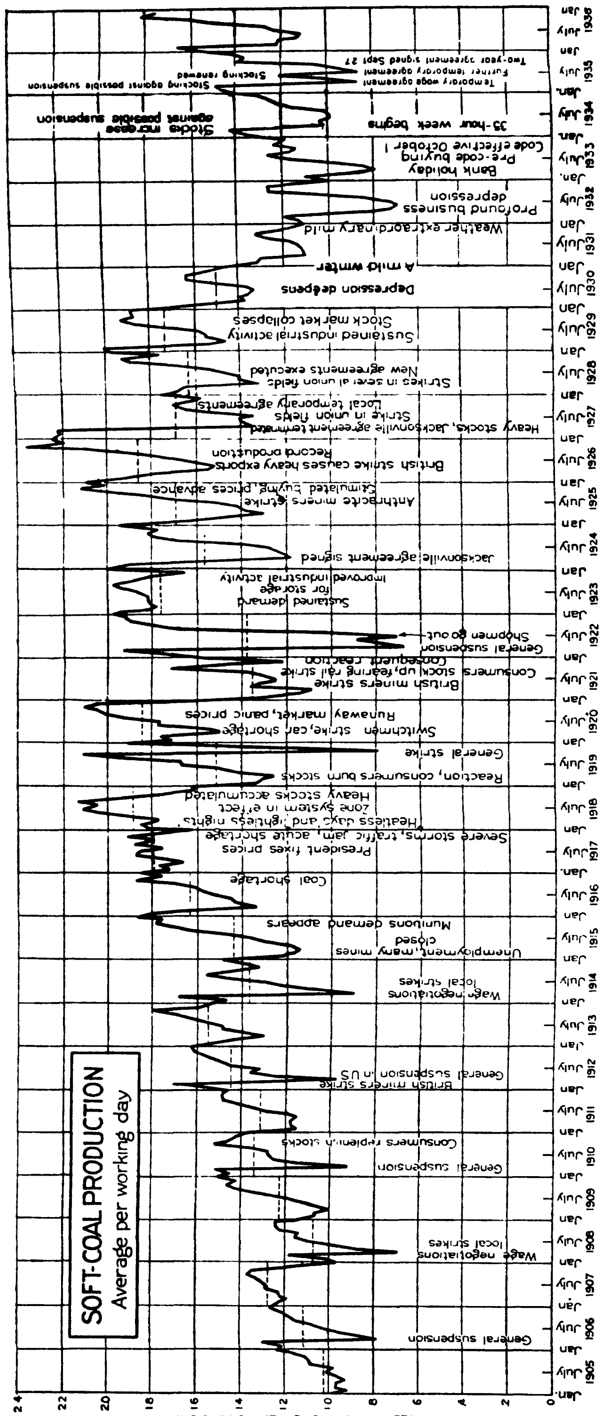


Figure 45.—Average production of bituminous coal per working day in each month, 1905–36.

covering 1,220 mines in 24 States, show an increase of 3 percent in number employed for 1936 over the previous year. Reports from the mining departments of three States which collect current records of employment indicate an average increase of 2.5 percent over 1935. If these indicators are correct, the total number of men employed at all mines in 1936 should fall somewhere between 467,000 and 476,000 men. In comparison with 1929, when the industry employed 502,993, this represents a decrease of 27,000 to 36,000 jobs.

However, the number of unemployed coal-mine workers probably exceeds 36,000, as even in 1929 considerable numbers of bituminous miners were entirely jobless.

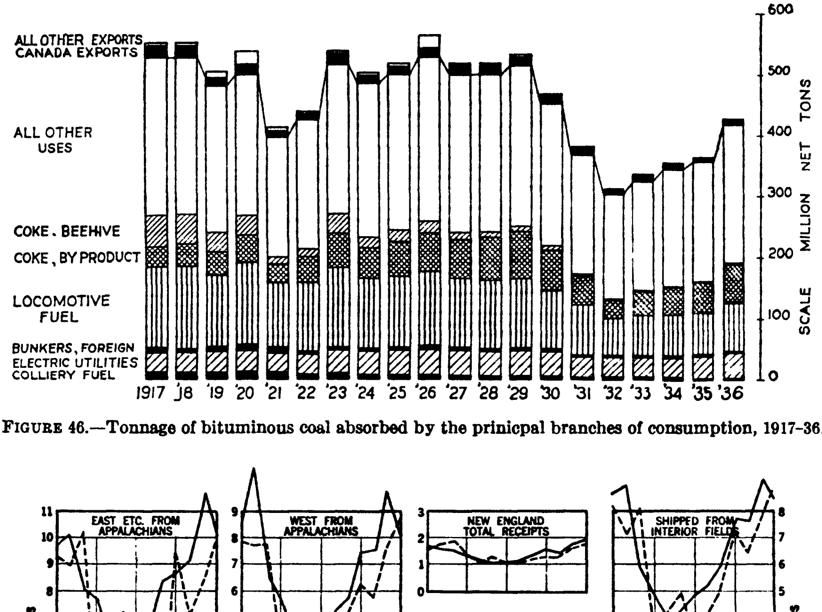


FIGURE 46.—Tonnage of bituminous coal absorbed by the prinicpal branches of consumption, 1917-36.

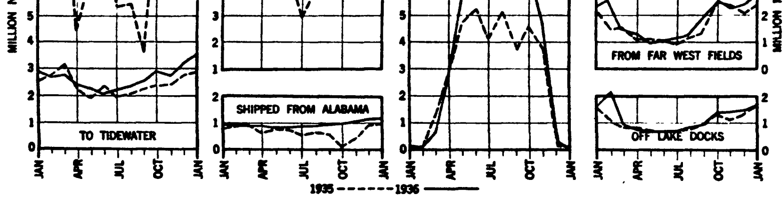


FIGURE 47.—Monthly movement of bituminous coal in the major channels of distribution, 1935–36.

The increase in number of men employed in 1936 was small in relation to the increase in production. There was, however, an improvement in running time and a substantial gain in total pay rolls. The average hours worked per week at the mines reporting to the Bureau of Labor Statistics rose from 26.3 hours in 1935 to 28.9 in 1936. Pay rolls during the same period increased 21.5 percent.[5]

[5] U. S. Bureau of Labor Statistics, Employment and Pay Rolls, November 1936, Serial No. R. 495. In February 1936 the average number of hours worked per week at mines reporting was 32.8 hours and in November 1936 31.8 hours.

Trend of capacity.—The latest statistics of mine capacity relate to 1935 (table 2). The long depression, which began in the coal industry immediately after 1923, had forced the closing or abandonment of several thousand mines and the liquidation of active capacity from 970,000,000 tons per year of 308 days in 1923 to 622,000,000 tons in 1934. In 1935, with more men at work and more machinery in use, there was a slight increase in capacity, and the total per year of 308 days amounted to 640,000,000 tons.

The figure of 308 days represents the potential full-time year before the limitation of hours effected by the National Recovery Act Bituminous-Coal Code in October 1933. Under the 5-day week now prevailing, the potential full-time year is approximately 261 days (without allowing for the possibility of staggering work). At 261 days the capacity active in 1935 was 543,000,000 tons against an actual production for the year of 372,373,122 tons.

Trend of fuel efficiency.—Among the largest consumers of coal, indicators point to the conclusion that the savings in fuel efficiency that have been so marked since the war are slowing down. Ten years ago the electric public-utility power plants were saving 6 percent a year in the coal required to generate 1 kilowatt-hour. In 1936, however, the average saving, as compared with the year before, was cut to 1.0 percent, or 0.02 pound per kilowatt-hour. On steam railroads the average consumption per 1,000 gross ton-miles in freight service was reduced from 120 pounds in 1935 to 119 in 1936—a saving of 0.8 percent. Ten or fifteen years ago the annual savings in railroad fuel were averaging 3 percent. (See fig. 53.)

On the other hand, great advances in fuel efficiency probably are continuing in the smaller industrial establishments and in the field of domestic consumption, which together account for a large fraction of the national demand.

Competition of oil and gas.—Competition of oil and gas continued active in 1936. Although the consumption of coal increased in the competitive steamship-bunker, electric-power plant, and railroad-fuel trades consumption of oil in the same trades increased still more. Gas-utility companies sold 6.1 percent more manufactured gas but 17.7 percent more natural gas than in 1935.[6] There was further expansion in the use of oil burners in the domestic fuel market.

Largely because of the revival of activity in the heavy industries and the pick-up in rail transportation, however, the proportion of bituminous coal in the national energy supply increased. At the low point of the depression, bituminous coal furnished 45.0 percent of the total energy production. In 1935 the proportion was 45.1 percent and in 1936, 47.1 percent. Compared with 1929, however, the proportion furnished by bituminous coal shows a marked decline (tables 8 to 10).

Statistical tables—1936.—Tables 1 to 7 give the statistical record of the bituminous-coal industry in 1936, as indicated by the preliminary data available as this report is written. (See fig. 48.)

[6] American Gas Association. (Figures cover first 11 months.)

TABLE 1.—*Bituminous coal in 1936 and comparisons with 1929–35*

[All tonnage figures represent net tons]

	1929	1932	1934	1935	1936 (preliminary)	Change 1935–36
Production	534,988,593	309,709,872	359,368,022	372,373,122	434,070,000	+16.6%
Exports to Canada and Mexico [1]	14,727,482	8,428,829	10,212,285	9,043,827	9,911,987	+9.6%
Exports overseas and all other [1]	2,701,816	385,218	656,267	698,603	742,973	+6.4%
Imports [1]	495,000	186,909	179,661	201,871	268,987	+33.2%
Consumption in the United States (calculated) [2]	519,555,000	306,917,000	347,043,000	360,291,563	417,202,600	+15.8%
Stocks at end of year:						
Industrial consumers and retail yards	40,300,000	29,666,000	34,476,000	37,017,000	43,499,000	+17.5%
Stocks on upper Lake docks	8,026,065	6,792,703	7,738,288	6,904,419	7,740,446	+12.1%
Unbilled loads, at mines or in classification yards [3]	841,000	1,493,700	1,735,900	1,371,500	1,402,050	+2.2%
Price indicators (average per net ton):						
Spot price, f.o.b. mines, trade-journal quotations [4]	(5)	(5)	(5)	$2.04	$1.99	−5¢
Average cost of railroad fuel, excluding freight [6]	$2.01	$1.66	$1.84	$1.89	$1.89	0
Average price paid by Canadian buyers, f.o.b. American mines [7]	$1.90	$1.32	$1.72	$1.79	[7] $1.73	−6¢
Average cost of coking coal at merchant byproduct ovens [8]	$4.22	$4.14	$4.37	$4.61	[8] $4.48	−3¢
Average cost of bunker coal to vessels in foreign trade [9]	$4.57	$4.10	$4.39	$4.66	[9] $4.60	−6¢
Average value of exports to all countries (at port) [10]	$3.77	$3.37	$3.72	$3.617	$3.623	+0.6¢
Average retail price—38 cities [11]	$8.85	$7.71	$8.26	$8.30	$8.40	+10¢
Value at mines, total	$952,781,000	$406,677,000	$628,383,000	$658,063,000	$768,000,000	+16.7%
Average value, all coal, f.o.b. mines (per net ton)	$1.78	$1.31	$1.75	$1.77	$1.77	0
Average railroad freight charge per net ton [12]	$2.25	$2.26	$2.15	$2.24	[12] $2.25	+1¢
Underground loading machinery sold to bituminous mines: [13]						
Mobile loading machines (number)	(5)	(5)	52	115	344	+199.1%
Scrapers (number)	(5)	(5)	15	14	19	+35.7%
Conveyors, including those with duckbills (units)	(5)	(5)	279	307	660	+115.0%
Pit-car loaders (units)	(5)	(5)	14	23	9	−60.9%
Average number of men employed at mines operating [14]	502,993	406,380	458,011	462,403	[14] 467,000 to 476,000	+1 to 3%
Fuel-efficiency indicators:						
Pounds coal per kw.-hr. at electric power plants [15]	1.69	1.50	1.47	1.46	1.45	−0.7%
Pounds per 1,000 gross ton-miles—railroads [16]	125	123	122	120	119	−0.8%
Percentage of total national energy supply supplied by bituminous coal [17]	52.8%	45.0%	46.1%	45.1%	47.1%	+2.0 points

[1] Figures on imports and exports compiled by M. B. Price, of the U. S. Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

[2] Production plus imports minus exports plus or minus net changes in consumers' stocks.

[3] Association of American Railroads.

[4] Unweighted average of spot price quotations, f.o.b. mines, on 61 grades and sizes of bituminous coal, as quoted currently in the Coal and Coal Trade Journal. Computed by J. R. Bradley. No attempt was made to weight the various coals nor to test the accuracy of quotations. The figures, however, give a rough measure of the trend of the spot market.

[5] Data not available.

[6] Interstate Commerce Commission. Excludes direct freight charges.

[7] Computed by J. R. Bradley from the Quarterly Trade Returns of the Canadian Government. The value of imports as recorded in the Canadian customs statistics represents the fair market price in the country of origin and excludes transportation costs.

[8] As reported by coke operators to the U. S. Bureau of Mines.

[9] Computed by J. R. Bradley from records of the Bureau of Foreign and Domestic Commerce. The average cost declined from $4.66 per net ton in 1935 to $4.60 in 1936.

[10] Computed from records of the Bureau of Foreign and Domestic Commerce. The figure represents the average value at the point of export of shipments to all foreign countries including Canada. Exports to overseas destinations only excluding those to Canada and Mexico, show an increase in average value per ton of 13 cents in 1936 over 1935, but it is uncertain how far this is affected by changes in grades and in freight rates.

[11] Bureau of Labor Statistics, with allowance for months between the quarterly returns.

[12] Average receipts per net ton of revenue bituminous coal originated, as reported by the Interstate Commerce Commission.

[13] Plein, L. N., and Tryon, F. G., Sales of Mechanical Loading and Cleaning Equipment for Use in Coal Mines in 1936: Min. Cong. Jour., February 1937, pp. 57–60.

[14] Figures for 1929 to 1935 are based on the detailed reports of all mine operators producing over 1,000 tons to the U. S. Bureau of Mines. The figure for 1936 is estimated from the monthly employment index of the U. S. Bureau of Labor Statistics, which covers about half of the men employed in the industry, and from current monthly reports of certain State mine departments The 1936 report of the Colorado mine inspector shows an increase in the number employed of 6.2 percent over 1935, that of the West Virginia Department of Mines shows an increase of 3.0 percent, while that of Illinois indicates no change over the preceding year.

[15] U. S. Geological Survey.

[16] Interstate Commerce Commission.

[17] See tables 8 to 10.

TABLE 2.—*Salient trends in bituminous mine operation, 1913–35*

	1913	1923	1929	1932	1934	1935
Production:						
Loaded at mines for shipment by rail......net tons..	392,743,412	488,974,496	474,868,165	276,142,037	313,303,729	319,741,376
Loaded at mines for shipment by water......do....	10,690,834	16,884,799	23,066,289	9,365,782	15,127,968	18,327,282
Made into coke at mines......do....	49,458,320	27,859,316	9,128,607	1,028,458	1,647,805	1,467,902
Used at mines for colliery fuel......do....	11,670,903	8,765,011	4,662,974	2,780,889	3,175,057	3,102,691
Commercial sales by truck or wagon......do....	13,871,828	22,081,040	23,262,558	20,392,706	[1] 18,739,320	21,960,252
Other local sales, used by employees, etc......do....					7,374,143	7,773,619
Total production......do....	478,435,297	564,564,662	534,988,593	309,709,872	359,368,022	372,373,122
Number of active mines of commercial size:						
Class 1 (200,000 tons or more)......number..	694	748	827	465	551	561
Class 2 (100,000 to 200,000 tons)......do....	837	935	660	477	485	479
Class 3 (50,000 to 100,000 tons)......do....	959	1,176	668	469	479	503
Class 4 (10,000 to 50,000 tons)......do....	1,558	2,742	1,361	1,111	1,072	1,056
Class 5 (1,000 to 10,000 tons)......do....	1,728	3,730	2,541	2,905	3,671	3,716
Total number over 1,000 tons......do....	5,776	9,331	6,057	5,427	[2] 6,258	[2] 6,315
Percent of output from mines in classes 1 and 2......percent..	75.4	70.4	83.1	77.5	80.5	80.7
Average number of men employed at mines active:						
Underground......men..	494,238	600,305	433,999	345,905	384,947	389,942
Surface, including strip pits......do....	77,644	104,488	68,994	60,475	73,064	72,461
Total......do....	571,882	704,793	502,993	406,380	458,011	462,403
Average number of days mines operated......days..	232	179	219	146	178	179
Nominal length of established full-time week [3]......hours..	51.6	48.4	48.5	48.6	40.0 and 35.1	35.1
Capacity of active mines with existing labor force:						
Per year of 308 days (full time before October 1933)......net tons..	635,000,000	970,000,000	752,000,000	653,000,000	622,000,000	640,000,000
Per year of 261 days (5-day week basis)......do....	538,000,000	823,000,000	638,000,000	554,000,000	527,000,000	543,000,000
Output per man per day [4]......do....	3.61	4.47	4.85	5.22	4.40	4.50
Output per man per year......do....	837	801	1,064	762	785	805
Underground output cut by machine......percent..	50.7	68.3	78.4	84.1	84.1	84.2
Underground output mechanically loaded......do....	----------	0.3	7.4	12.6	12.2	13.5
Quantity mined by stripping......net tons..	[5] 1,280,946	11,940,134	20,268,099	19,641,128	20,789,641	23,647,292
Quantity cleaned by wet or pneumatic processes [6]......do....	22,069,691	20,140,385	32,271,950	27,357,599	35,853,714	39,511,176

[1] The earliest year in which figures were collected in strictly comparable form was 1933, when commercial sales by truck and wagon were 15,462,739 tons.
[2] The increase in number of mines shown for 1934 and 1935 over preceding years is largely due to more complete coverage of small trucking mines made possible by cooperation of the N. R. A. divisional code authorities. See Minerals Yearbook, 1936, pp. 561–564.
[3] The figures represent the full-time week as reported by the operator, not the hours actually worked by the men.
[4] Affected by changes in length of working day.
[5] Figures for 1914, the year of earliest record.
[6] Exclusive of central washeries operated by consumers.

TABLE 3.—*Preliminary statistics of coal production in 1936, by States, with final figures for earlier years*

State	Production (thousands of net tons)							Change, percent, 1935–36	Percent of total bituminous						
	1913	1923	1929	1932	1934	1935	1936 preliminary		1913	1923	1929	1932	1934	1935	1936 preliminary
Alaska	2	120	101	103	108	119	138	+16.0	(1)	.02	.02	.03	.03	.03	.03
Alabama	17,678	20,458	17,944	7,857	9,142	8,505	11,730	+37.9	3.69	3.62	3.35	2.54	2.54	2.29	2.70
Arkansas	2,234	1,297	1,695	1,033	856	1,133	3,125	+32.3	.47	.23	.32	.33	.24	.30	.72
Oklahoma	4,166	2,885	3,774	1,255	1,208	1,229			.87	.51	.71	.41	.34	.33	
Colorado	9,232	10,346	9,921	5,599	5,211	5,911	6,768	+14.5	1.93	1.83	1.85	1.81	1.45	1.59	1.56
Georgia	256	76	45	27	33	23	23	0	.05	.01	.01	.01	.01	.01	.01
North Carolina	-----	36	52	2	3					.01	.01				
Illinois	61,619	79,310	60,658	33,475	41,272	44,525	50,526	+13.5	12.88	14.05	11.34	10.81	11.48	11.96	11.64
Indiana	17,166	26,229	18,344	13,324	14,794	15,754	17,410	+10.5	3.59	4.65	3.43	4.30	4.12	4.23	4.01
Iowa	7,526	5,711	4,241	3,862	3,367	3,650	3,550	−2.7	1.57	1.01	.79	1.25	.94	.98	.82
Kansas	7,202	4,443	2,976	1,953	2,508	2,686	6,650	+5.0	1.51	.79	.56	.63	.70	.72	1.53
Missouri	4,318	3,403	4,030	4,070	3,352	3,646			.90	.60	.75	1.31	.93	.98	
Kentucky: Eastern	11,099	33,887	46,025	25,760	30,311	32,627	39,150	+20.0	2.32	6.00	8.60	8.32	8.44	8.76	9.02
Western	8,518	10,890	14,437	9,540	8,215	8,134	8,420	+3.5	1.78	1.93	2.70	3.08	2.29	2.18	1.94
Maryland	4,780	2,286	2,649	1,429	1,627	1,678	1,695	+1.0	1.00	.40	.50	.46	.45	.45	.39
Michigan	1,232	1,172	805	446	622	628	580	−7.6	.26	.21	.15	.14	.17	.17	.13
Montana	3,241	3,148	3,408	2,125	2,566	2,759	3,195	+15.8	.68	.56	.64	.69	.71	.74	.74
New Mexico	3,709	2,915	2,623	1,263	1,259	1,389	1,600	+15.2	.78	.52	.49	.41	.34	.37	.37
North Dakota	495	1,386	1,862	1,740	1,754	1,956	2,258	+14.7	.10	.25	.35	.56	.49	.52	.52
South Dakota	11	11	13	49	42	13			(1)	(1)	(1)	.02	.01	(1)	
Ohio	36,200	40,546	23,689	13,909	20,691	21,153	23,030	+8.9	7.57	7.18	4.43	4.49	5.76	5.68	5.30
Pennsylvania (bituminous)	173,781	171,880	143,516	74,776	89,826	91,405	108,527	+18.7	36.32	30.45	26.83	24.14	25.00	24.55	25.00
Tennessee	6,860	6,040	5,406	3,538	4,136	4,138	5,070	+22.5	1.43	1.07	1.01	1.14	1.15	1.11	1.17
Texas	2,429	1,187	1,101	637	759	758	780	+2.9	.51	.21	.20	.21	.21	.20	.18
Utah	3,255	4,720	5,161	2,852	2,406	2,947	3,170	+7.6	.68	.84	.97	.92	.67	.79	.73
Virginia	8,828	11,762	12,748	7,692	9,377	9,667	11,630	+20.3	1.85	2.08	2.38	2.48	2.61	2.60	2.68
Washington	3,878	2,926	2,521	1,591	1,383	1,559	1,750	+12.3	.81	.52	.47	.51	.38	.42	.41
West Virginia	71,254	107,900	138,519	85,609	98,134	99,179	117,485	+18.5	14.89	19.11	25.89	27.64	27.31	26.64	27.06
Wyoming	7,393	7,575	6,705	4,171	4,368	5,177	5,785	+11.7	1.55	1.34	1.25	1.35	1.22	1.39	1.33
Other States [2]	73	20	20	23	38	25	25	0	.01	(1)	(1)	.01	.01	.01	.01
Total bituminous	478,435	564,565	534,989	309,710	359,368	372,373	434,070	+16.6	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Pennsylvania anthracite	91,525	93,339	73,828	49,855	57,168	52,159	54,760	+5.0	-----	-----	-----	-----	-----	-----	-----
Grand total	569,960	657,904	608,817	359,565	416,536	424,532	488,830	+15.1	-----	-----	-----	-----	-----	-----	-----

[1] Less than 0.01.
[2] Includes Arizona, California, Idaho, Nebraska, Nevada, and Oregon. The States reporting are not identical from year to year.

TABLE 4.—*Estimated monthly production of coal, in 1936, by States (in thousands of net tons)*

[For notes as to sources and tonnage included see "Sources of data and acknowledgments." For certain States, the estimates here presented, which are based on latest available data, differ slightly from the current figures previously published in the Weekly Coal Reports]

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
Alaska	11	9	11	12	11	11	11	14	16	12	10	10	138
Alabama	1,040	1,036	910	940	890	857	897	916	993	1,034	1,050	1,167	11,730
Arkansas and Oklahoma	464	490	139	69	58	86	143	235	334	401	335	371	3,125
Colorado	756	858	490	426	284	305	293	400	565	785	736	870	6,768
Georgia and North Carolina	2	2	2	2	2	2	1	2	2	2	2	2	23
Illinois	5,580	5,810	3,984	3,227	2,492	2,763	3,125	3,483	3,756	5,123	5,062	6,121	50,526
Indiana	1,910	1,823	1,566	1,232	1,005	1,016	1,018	1,150	1,316	1,668	1,700	2,006	17,410
Iowa	467	425	299	241	195	207	202	195	266	319	344	390	3,550
Kansas and Missouri	829	808	528	391	334	333	411	454	527	627	633	775	6,650
Kentucky: Eastern	3,560	3,398	2,631	2,816	2,996	2,920	2,995	3,091	3,373	3,920	3,748	3,702	39,150
Western	970	981	543	538	389	432	509	590	695	825	898	1,050	8,420
Maryland	182	188	125	130	108	116	120	130	142	150	130	174	1,695
Michigan	67	85	70	54	13	6	16	18	54	52	67	78	580
Montana	350	350	282	193	150	183	193	210	265	334	343	362	3,195
New Mexico	152	155	110	115	99	109	122	111	118	163	156	190	1,600
North and South Dakota	372	347	153	120	51	48	63	70	172	338	282	242	2,258
Ohio	2,257	2,325	1,740	1,669	1,411	1,433	1,558	1,685	1,843	2,333	2,249	2,527	23,030
Pennsylvania	8,505	9,046	7,208	7,864	7,786	8,010	8,939	8,901	9,706	10,745	10,368	11,449	108,527
Texas	68	65	64	62	60	59	57	61	67	70	80	67	780
Tennessee	492	506	370	402	307	321	362	363	456	488	478	525	5,070
Utah	376	415	200	190	122	108	107	168	333	380	383	388	3,170
Virginia	1,010	1,045	767	796	762	777	900	930	1,060	1,213	1,145	1,225	11,630
Washington	157	204	130	115	95	103	118	114	176	182	170	186	1,750
West Virginia: Southern [1]	7,360	7,588	6,514	6,411	6,510	6,932	7,308	7,387	8,138	8,928	8,188	8,376	89,640
Northern [2]	2,320	2,515	2,293	2,032	2,235	1,765	2,180	2,014	2,302	2,600	2,707	2,882	27,845
Wyoming	536	678	415	405	317	313	355	392	515	627	613	619	5,785
Other States	2	2	3	2	2	2	2	2	2	2	2	2	25
Total bituminous	39,795	41,154	31,527	30,454	28,684	29,217	32,005	33,086	37,192	43,321	41,879	45,756	434,070
Pennsylvania anthracite	5,333	6,975	3,061	4,773	5,121	4,306	3,925	3,503	3,874	4,608	4,334	4,947	54,760
Grand total	45,128	48,129	34,588	35,227	33,805	33,523	35,930	36,589	41,066	47,929	46,213	50,703	488,830

[1] Includes operations on the N. & W., C. & O., Virginian, K. & M., B. C. & G., and on the B. & O. in Kanawha, Mason, and Clay Counties.
[2] Rest of State, including the Panhandle district, and Grant, Mineral, and Tucker Counties.

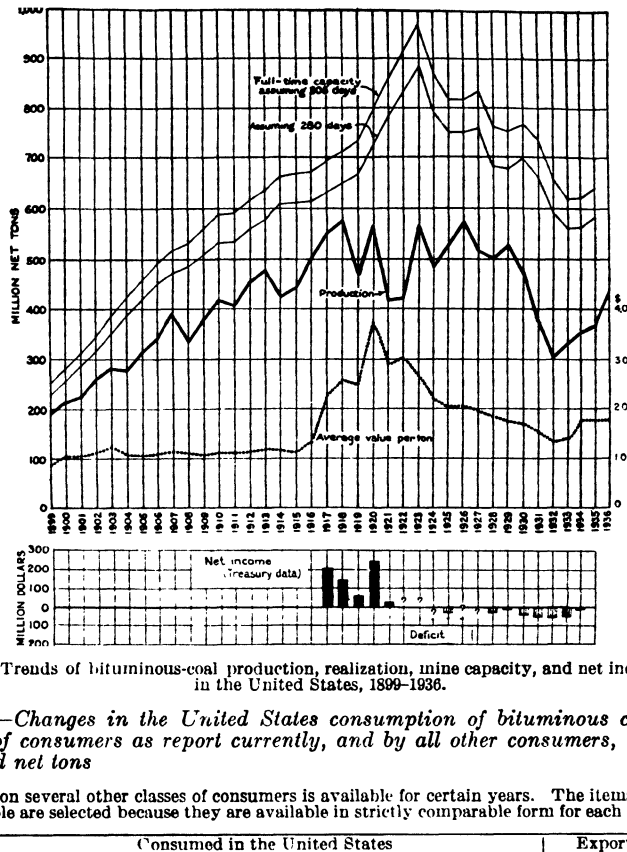


FIGURE 48.—Trends of bituminous-coal production, realization, mine capacity, and net income or deficit in the United States, 1899–1936.

TABLE 5.—*Changes in the United States consumption of bituminous coal by such classes of consumers as report currently, and by all other consumers, 1917–36, in thousand net tons*

[Information on several other classes of consumers is available for certain years. The items shown in this table are selected because they are available in strictly comparable form for each year]

Year	Consumed in the United States								Exported		Total of consumption and exports[7]
	Colliery fuel	Electric power utilities[1]	Bunkers, foreign trade[2]	Locomotive fuel, class I roads[3]	Coke: Beehive ovens[4]	Coke: By-product ovens[4]	All other uses[5]	Total consumption[6]	To Canada and Mexico	To other countries (seaborne)	
1917	12, 117	33, 500	7, 709	133, 421	52, 247	31, 506	258, 909	529, 409	18, 327	5, 512	553, 248
1918	12, 521	34, 500	6, 189	134, 214	48, 160	36, 868	258, 141	530, 593	18, 316	4, 034	552, 943
1919	11, 062	35, 100	8, 224	119, 692	29, 730	35, 857	241, 993	481, 658	12, 064	8, 050	501, 772
1920	11, 896	37, 124	10, 486	135, 414	31, 986	44, 205	237, 484	508, 595	16, 458	22, 059	547, 112
1921	9, 123	31, 585	8, 453	107, 910	8, 475	28, 713	197, 590	391, 849	13, 590	9, 541	414, 980
1922	7, 831	34, 179	4, 615	113, 163	13, 286	41, 053	212, 788	426, 915	10, 938	1, 475	439, 328
1923	8, 765	38, 966	5, 093	131, 492	30, 084	54, 276	250, 317	518, 993	16, 960	4, 494	540, 447
1924	6, 618	37, 556	4, 460	117, 247	15, 914	49, 061	253, 148	484, 004	12, 746	4, 354	501, 104
1925	5, 776	40, 222	4, 866	117, 714	17, 423	57, 110	256, 082	499, 193	13, 547	3, 915	516, 655
1926	5, 728	41, 311	7, 736	122, 823	19, 225	63, 647	272, 111	532, 581	13, 762	21, 510	567, 853
1927	4, 930	41, 888	4, 565	115, 883	11, 208	63, 240	258, 087	499, 801	14, 724	3, 288	517, 813
1928	4, 602	41, 350	4, 294	112, 382	7, 018	70, 166	259, 016	498, 828	14, 050	2, 114	514, 992
1929	4, 663	44, 937	4, 287	113, 894	10, 028	76, 759	264, 987	519, 555	14, 727	2, 702	536, 984
1930	3, 993	42, 898	3, 497	98, 400	4, 284	65, 521	236, 397	454, 990	13, 667	2, 210	470, 867
1931	3, 205	38, 735	2, 195	81, 725	1, 767	46, 846	197, 396	371, 869	10, 647	1, 479	383, 995
1932	2, 781	30, 290	1, 350	66, 498	1, 030	30, 887	174, 081	306, 917	8, 429	385	315, 731
1933	2, 858	30, 575	1, 316	66, 198	1, 461	38, 681	180, 659	321, 748	8, 600	437	330, 785
1934	3, 175	33, 555	1, 321	70, 496	1, 635	44, 343	192, 518	347, 043	10, 213	656	357, 912
1935	3, 103	34, 807	1, 576	71, 335	1, 469	49, 046	198, 956	360, 292	9, 044	698	370, 034
1936[8]	3, 606	41, 973	1, 630	80, 751	2, 893	63, 976	222, 374	417, 203	9, 912	743	427, 858

[1] U. S. Geol. Survey and Federal Power Commission. Represents all coal consumed by public utility power plants in power generation, including a small amount of anthracite.
[2] Bureau of Foreign and Domestic Commerce.
[3] Interstate Commerce Commission. Represents bituminous coal consumed as locomotive fuel by class I steam railways, excluding switching and terminal companies. Figure for 1936 partly estimated.
[4] U. S. Bureau of Mines.
[5] Obtained by subtracting the known items from the calculated total consumption. Includes general manufacturing, domestic and many miscellaneous uses.
[6] Production plus imports minus exports, plus or minus changes in consumers' stocks.
[7] Note that consumption includes the small amount imported.
[8] Preliminary.

TABLE 6.—*Trends in distribution of bituminous coal, 1923–36 (tonnage figures in thousands of net tons)*

[For details and sources of data see Monthly Report on Distribution of Coal Shipments]

	1923		1929		1932		1933	
	Net tons	Percent	Net tons	Percent	Net tons	Percent	Net tons	Percent
New England receipts:								
Via rail across the Hudson	9,634	41.9	6,781	31.9	4,544	30.0	4,787	29.7
Via tidewater from northern ports	3,703	16.1	1,570	7.4	704	4.6	791	4.9
Via tidewater from southern ports	9,671	42.0	12,875	60.7	9,914	65.4	10,560	65.4
Total	23,008	100.0	21,226	100.0	15,162	100.0	16,138	100.0
Tidewater loadings:								
By ports:								
At New York and Philadelphia	14,693	39.2	12,226	32.1	9,197	34.3	8,493	31.3
At Baltimore, Hampton Roads, and Charleston	22,828	60.8	25,825	67.9	17,580	65.7	18,633	68.7
Total	37,521	100.0	38,051	100.0	26,777	100.0	27,126	100.0
By fields of origin:								
From Pennsylvania and northern West Virginia	19,760	52.7	15,516	40.8	10,226	38.2	9,698	35.8
From southern low-volatile	13,619	36.3	17,103	44.9	11,670	43.6	12,892	47.5
From southern high-volatile	4,142	11.0	5,432	14.3	4,881	18.2	4,536	16.7
Total	37,521	100.0	38,051	100.0	26,777	100.0	27,126	100.0
By destination:								
To New England	13,374	35.6	14,445	38.0	10,618	39.7	11,351	41.8
Foreign	5,122	13.7	2,852	7.5	411	1.5	501	1.9
Bunkers	5,442	14.5	5,507	14.5	1,574	5.9	1,570	5.8
Inside capes and other tonnage	13,583	36.2	15,247	40.0	14,174	52.9	13,704	50.5
Total	37,521	100.0	38,051	100.0	26,777	100.0	27,126	100.0
Lake Erie loadings (cargo and fuel):								
By fields of origin:								
From Ohio	6,417	20.9	3,734	9.5	1,613	6.4	2,588	8.0
From Pittsburgh and other Pennsylvania	9,980	32.4	8,586	21.8	7,761	30.8	8,914	27.6
From Moundsville, Fairmont, Cumberland-Piedmont	3,277	10.7	2,184	5.5	1,278	5.1	1,311	4.1
From southern West Virginia, high-volatile	4,994	16.2	10,233	26.0	6,025	23.9	7,363	22.7
From southern West Virginia, low-volatile	2,871	9.3	7,656	19.4	4,202	16.7	6,544	20.2
From east Kentucky, Tennessee, and Virginia	3,229	10.5	6,991	17.8	4,294	17.1	5,613	17.4
Total	30,768	100.0	39,384	100.0	25,173	100.0	32,333	100.0
By destinations (cargo only):								
To American points	24,172	81.5	31,943	84.2	20,014	81.7	26,065	83.1
To Canadian points	5,475	18.5	6,007	15.8	4,477	18.3	5,314	16.9
Total	29,647	100.0	37,950	100.0	24,491	100.0	31,379	100.0
Across Lake Michigan car ferry	1,373		1,282		714		746	
West-bound rail to Mississippi Valley:[2]								
From Ohio	22,970	14.7	12,912	7.8	7,823	8.8	10,965	12.1
From Pennsylvania	15,853	10.1	21,885	13.3	7,842	8.8	6,640	7.3
From northern West Virginia-Cumberland-Piedmont	2,509	1.6	5,464	3.3	2,871	3.2	3,127	3.4
From southern West Virginia, high-volatile	17,525	11.2	25,148	15.3	13,733	15.4	14,048	15.5
From southern West Virginia, low-volatile	13,535	8.6	23,691	14.4	13,743	15.4	14,490	15.9
From east Kentucky, Tennessee, and Virginia	17,789	11.3	24,057	14.6	12,479	14.1	12,809	14.1
Total from Appalachian fields	90,181	57.5	113,157	68.7	58,491	65.7	62,079	68.3

See footnotes at end of table.

TABLE 6.—*Trends in distribution of bituminous coal, 1923–36 (tonnage figures in thousands of net tons)*—Continued

[For details and sources of data see Monthly Report on Distribution of Coal Shipments]

	1923		1929		1932		1933	
	Net tons	Percent	Net tons	Percent	Net tons	Percent	Net tons	Percent
West-bound rail to Mississippi Valley—Continued.								
From Illinois	48,401	30.9	34,863	21.2	17,783	20.0	18,229	20.0
From Indiana	14,549	9.3	10,589	6.4	8,490	9.5	8,098	8.9
From west Kentucky [3]	3,569	2.3	6,175	3.7	4,201	4.8	2,545	2.8
Total from Middle West fields	66,519	42.5	51,627	31.3	30,474	34.3	28,872	31.7
Grand total	156,700	100.0	164,784	100.0	88,965	100.0	90,951	100.0
Total shipments from other groups: [4]								
From Michigan	1,086	[5] .2	745	[5] .1	341	[5] .1	241	[5] .1
From upper lake docks, all deliveries	No data		No data		11,468	[5] 3.7	11,390	[5] 3.4
From Iowa, Missouri, Kansas	12,222	[5] 2.2	9,488	[5] 1.8	7,818	[5] 2.5	6,621	[5] 2.0
From Arkansas, Oklahoma, Texas	5,125	[5] .9	6,337	[5] 1.2	2,815	[5] .9	2,840	[5] .9
From far western fields	30,286	[5] 5.4	29,705	[5] 5.6	16,706	[5] 5.4	15,840	[5] 4.7
From Alabama	19,569	[5] 3.5	17,503	[5] 3.3	7,577	[5] 2.4	8,506	[5] 2.5

	1934		1935		1936	
	Net tons	Percent	Net tons	Percent	Net tons	Percent
New England receipts:					*Preliminary*	
Via rail across the Hudson	5,422	31.6	5,210	30.9	5,000	28.5
Via tidewater from northern ports	1,089	6.3	1,067	6.3	755	4.3
Via tidewater from southern ports	10,662	62.1	10,606	62.8	11,774	67.2
Total	17,173	100.0	16,883	100.0	17,529	100.0
Tidewater loadings:						
By ports:						
At New York and Philadelphia	9,120	31.7	8,885	30.7	9,203	29.7
At Baltimore, Hampton Roads, and Charleston	19,623	68.3	20,080	69.3	21,823	70.3
Total	28,743	100.0	28,965	100.0	31,026	100.0
By fields of origin:						
From Pennsylvania and northern West Virginia	10,647	37.1	10,711	37.0	11,344	36.6
From southern low-volatile	13,745	47.8	13,922	48.1	15,021	48.4
From southern high-volatile	4,351	15.1	4,332	14.9	4,661	15.0
Total	28,743	100.0	28,965	100.0	31,026	100.0
By destination:						
To New England	11,751	40.9	11,673	40.3	12,530	40.4
Foreign	715	2.5	798	2.8	837	2.7
Bunkers	1,545	5.4	1,655	5.7	1,648	5.3
Inside capes and other tonnage	14,732	51.2	14,839	51.2	16,011	51.6
Total	28,743	100.0	28,965	100.0	31,026	100.0

See footnotes at end of table.

TABLE 6.—*Trends in distribution of bituminous coal, 1923–36 (tonnage figures in thousands of net tons)*—Continued

[For details and sources of data see Monthly Report on Distribution of Coal Shipments]

	1934		1935		1936	
	Net tons	Percent	Net tons	Percent	Net tons	Percent
Lake Erie loadings (cargo and fuel):					*Preliminary*	
By fields of origin:						
From Ohio	2,625	7.3	2,267	6.3	2,908	6.4
From Pittsburgh and other Pennsylvania	10,941	30.4	10,102	28.2	11,222	24.7
From Moundsville, Fairmont, Cumberland-Piedmont	1,313	3.7	1,174	3.3	1,648	3.6
From southern West Virginia, high-volatile	7,779	21.6	7,752	21.6	10,459	23.0
From southern West Virginia, low-volatile	6,864	19.1	7,404	20.7	10,103	22.3
From east Kentucky, Tennessee, and Virginia	6,449	17.9	7,138	19.9	9,101	20.0
Total	35,971	100.0	35,837	100.0	45,441	100.0
By destinations (cargo only):						
To American points	28,399	81.5	28,680	82.5	37,185	84.5
To Canadian points	6,440	18.5	6,097	17.5	6,835	15.5
Total	34,839	100.0	34,777	100.0	44,020	100.0
Across Lake Michigan car ferry	680		648		[1] 712	
West-bound rail to Mississippi Valley:[2]						
From Ohio	11,321	11.3	11,228	10.6	[1] 10,314	9.5
From Pennsylvania	11,013	11.0	11,171	10.6	[1] 12,573	11.6
From northern West Virginia-Cumberland-Piedmont	3,271	3.3	3,081	2.9	[1] 3,009	2.8
From southern West Virginia, high-volatile	14,912	14.9	15,868	15.0	[1] 16,601	15.3
From southern West Virginia, low-volatile	14,916	14.9	15,644	14.8	[1] 17,009	15.7
From east Kentucky, Tennessee, and Virginia	13,463	13.4	14,734	14.0	[1] 15,296	14.2
Total from Appalachian fields	68,896	68.8	71,726	67.9	[1] 74,802	69.1
From Illinois	20,208	20.2	22,752	21.5	[1] 23,165	21.4
From Indiana	8,879	8.8	9,080	8.6	[1] 8,638	8.0
From west Kentucky[3]	2,208	2.2	2,108	2.0	[1] 1,625	1.5
Total from Middle West fields	31,295	31.2	33,940	32.1	[1] 33,428	30.9
Grand total	100,191	100.0	105,666	100.0	108,230	100.0
Total shipments from other groups:[4]						
From Michigan	325	[5] .1	264	[5] .1	221	[5] .1
From upper lake docks, all deliveries	11,535	[5] 3.2	11,737	[5] 3.2	13,768	[5] 3.2
From Iowa, Missouri, Kansas	7,007	[5] 1.9	7,324	[5] 2.0	7,671	[5] 1.8
From Arkansas, Oklahoma, Texas	2,692	[5] .7	2,975	[5] .8	3,956	[5] .9
From far western fields	16,368	[5] 4.6	18,570	[5] 5.0	21,141	[5] 4.9
From Alabama	8,812	[5] 2.5	8,109	[5] 2.2	11,264	[5] 2.6

[1] Total for 11 months only.
[2] Revenue all-rail shipments, excluding railroad fuel, lake coal, and movement to Kentucky points.
[3] The figures for west Kentucky cover in recent years a much smaller percentage of the field's production than do those for Illinois and Indiana, and may not be fully comparable with earlier years.
[4] All shipments, including, in this case, nonrevenue, railroad fuel; excluding commercial sales by truck or wagon except from upper lake docks.
[5] Percent of total national shipments from all mines, all destinations.

TABLE 7.—*Average price of bituminous coal f. o. b. mines, average freight charge, and computed delivered cost at consignee's siding, per net ton, 1923, and 1928–36*

Year	(1) Average sales realization per ton [1] f. o. b. mines	(2) Average freight charge per ton [2]	(3) Total delivered cost (1)+(2)	(4) Percent freight charges of total
1923	$2.68	[3] $2.36	$5.04	46.9
1928	1.86	2.27	4.13	55.0
1929	1.78	2.25	4.03	55.8
1930	1.70	2.23	3.93	56.7
1931	1.54	2.22	3.76	59.0
1932	1.31	2.26	3.57	63.3
1933	1.34	2.20	3.54	62.1
1934	1.75	2.15	3.90	55.1
1935	1.77	2.24	4.01	55.9
1936 [4]	1.77	2.25	4.02	56.0

[1] Value of all coal including nonrevenue railroad fuel and deliveries of captive coal to consumer owners, as reported by operators to the U. S. Bureau of Mines.
[2] Average revenue received by class I steam railroads per net ton of revenue bituminous coal originated, as reported to Interstate Commerce Commission.
[3] Interstate Commerce Commission, Bureau of Statistics, Report 23157.
[4] Preliminary.

SOURCES OF DATA AND ACKNOWLEDGMENTS

Detailed annual statistics.—The data on operation of bituminous-coal mines for 1935 and earlier years given in this report are based upon detailed annual reports courteously furnished by the producers. The figures include all known operations producing more than 1,000 tons a year.[7]

In the present report the standard unit of measurement is the net or short ton of 2,000 pounds.

These reports, like all others collected by the Bureau of Mines, depend upon voluntary cooperation of the producing companies. The Bureau has no power to compel the submission of reports and has sought none. The system of voluntary reporting has been in use since 1883, when these statistics were inaugurated by the United States Geological Survey, and has served a useful purpose in measuring the simpler facts of production, supply and demand, trends of employment, mechanical equipment, operating practice, and output per man. The voluntary system of reporting is not adapted to the recording of costs, investments, profits, or, it is believed, to the controversial aspects of price differentials, wage rates, and hourly earnings.

The reports of production submitted directly to the Bureau have in most years accounted for fully 97 percent of the total production; and the remaining output, representing chiefly very small mines, has been ascertained with reasonable accuracy from the records of the State departments of mines, which have statutory authority to require reports, or occasionally from railroad carloadings.

In 1935 the Bureau was unable to obtain direct reports from several larger companies whose output ranged from 100,000 to 1,250,000 tons a year. The more important of these operators have mines in Fremont, Las Animas, and Routt Counties, Colo.; Harlan, Hopkins, and Letcher Counties, Ky.; and Greene, Indiana, and West-

[7] Production figures for 1913 include a certain tonnage from small mines producing less than 1,000 tons a year and those given for 1923 include 1,141,431 tons from "wagon mines shipping by rail."

moreland Counties, Pa. In each instance it was possible to obtain the tonnage, men employed, and days worked by these companies from the public records of the Department of Mines of the State in question; therefore the totals for tonnage, employment, and operating time are believed to be complete and comparable with earlier years.

To the thousands of other companies who continued to cooperate on the voluntary basis, responding courteously to the Bureau's request for information, cordial thanks are extended.

Current production statistics.—The figures of production in 1936 are preliminary estimates based upon (1) railroad carloadings of coal and beehive coke reported weekly or monthly by all the important carriers, (2) shipments by river reported by the United States Engineers, (3) direct reports from a number of mining companies, and (4) monthly production statements compiled by certain local operators' associations and State mine departments. Monthly or weekly reports are received from the Coal Trade Association of Indiana, Hazard Coal Operators Association, Harlan County Coal Operators Association, Kanawha Coal Operators Association, Eastern Ohio Operators Association, New River Coal Operators Association, North Dakota Board of Railroad Commissioners, Utah Coal Operators Association, Virginia Operators Association, West Kentucky Coal Bureau, Winding Gulf Operators Association, and Operators Association of the Williamson Field. Especial acknowledgment for detailed monthly production reports is made to Thomas Allen, Colorado inspector of coal mines; James McSherry, director, Illinois Department of Mines and Minerals; M. J. Hartneady, secretary, Pennsylvania Department of Mines; and N. P. Rhinehart, chief, West Virginia Department of Mines.

In making the estimates, allowance is made for commercial truck shipments, local sales and colliery fuel, and for small trucking or wagon mines producing over 1,000 tons a year. Where a mine is on the border between two States, the production is credited to the State from which the coal is extracted rather than that in which the tipple is located. If the mine extracts coal from lands in both States, the tonnage is apportioned accordingly.

Anthracite and lignite.—The statistics of bituminous coal include, for convenience, the small output of anthracite and semianthracite produced outside Pennsylvania and the production of lignite. Details regarding these coals are given in tables 46 and 47.

The anthracite mines of Pennsylvania, on the other hand, are recognized as a distinct industry and treated separately in part II.

Value at mines defined.—In reporting value of product, the operator is asked to state the "Amount received at the mines, f. o. b. cars, less the selling expense. Value of coal not sold but used by producer, also mine fuel, and coal made into coke should be estimated at average prices that might have been received."

The returns of total value and average value of "sales realization" per ton should be used with these instructions in mind. The figures do not purport to include selling expense; and they are affected, especially in some areas, by the large tonnage of captive coal, the average value reported for which may differ materially from that for sales on the competitive market.

As the inquiry regarding value has been carried in the same form for many years, the replies should furnish a reliable index to the rise and fall in the level of coal prices.

Estimates of value included in statistics.—If an operator who is known to have produced coal during the year will make no report of the value of his product to the Bureau of Mines, an estimate of the value is included in the total to make it complete; as, for instance, in Alabama, where for 7.8 percent of the State's known production no value was reported by the operators.

These estimates are based on a study of the reports of all similarly situated operators in the same county who did report their values.

For several years the proportion of the total value covered by actual reports has exceeded 95 percent. In 1935, because of lack of reports from certain companies of larger size mentioned above, the percentage covered by actual returns to the Bureau of Mines was somewhat smaller. Out of the $658,063,000 given as the total value of bituminous coal at the mines, $624,092,000 represents actual reports submitted by the operators to the Bureau or to the State governments, and $33,971,000 (5.2 percent) represents estimates made in the manner described. The largest proportion represented by estimates in any State was 28.8 percent in Oklahoma; and the smallest was 1.4 percent in Utah.

The average value per ton or sales realization computed for 1935, which amounts to $1.77, is therefore not a complete count, but essentially a sample based upon 94.8 percent of the known tonnage of the industry.

RELATIVE RATE OF GROWTH OF COAL, OIL, AND WATER POWER, 1889–1936

According to preliminary data the total supply of available energy in the form of coal, oil, and natural gas, and water power in 1936 was 24,134 trillion B. t. u., an increase of 11.7 percent over the year before. This was the largest production of energy in any year since 1929. (See fig. 49.)

The figures are expressed in British thermal units because some common denominator is necessary for such unlike quantities as tons of coal, barrels of oil, and cubic feet of gas. Table 8 summarizes the equivalent in British thermal units of each of the fuels. Water power is represented by the equivalent fuel required to perform the same work.

In converting water power into its fuel equivalent, two alternative assumptions have been made. The first, as in previous issues of these tables, assumes a *constant* fuel equivalent of 4 pounds of coal for each kilowatt-hour of water power produced, throughout the entire period covered by the tables from 1889 to 1936. This factor was selected because it represents in round numbers the average efficiency of all central stations generating steam-electric power in 1913, the midpoint of the period under review. The usefulness of the *constant* factor lies in showing the rate at which water power is being developed. It permits direct comparison between the relative increase in kilowatt-hours of water power and the corresponding increase (or decrease) in tons of coal, barrels of oil, or cubic feet of gas produced. On the other hand, the constant factor makes no allowance for the fact that

coal and other fuels produced today are used more efficiently than formerly.

To throw light on the influence of improving fuel efficiency, a second computation of the energy equivalent of water power has therefore been made. This assumes a *prevailing* fuel equivalent, diminishing year by year, which represents the average performance of all fuel-burning central electric stations for the year in question. This average has declined from about 7.05 pounds of coal per kilowatt-hour in 1899 to 1.44 pounds in 1936. (The *prevailing* factor is thus much above the *constant* factor in 1899 and much below it in 1936.) The *prevailing* fuel equivalent indicates more nearly the amount of fuel that would have been needed in any one year to generate the same power in a steam-electric station. It should be noted, however, that the ultimate uses to which the water power generated is put often displace fuel burned much less efficiently than in central stations and that in any instance no other important branch of fuel consumption has shown advances in fuel efficiency approaching that of the central stations.[8]

As these tables attempt to determine the total energy from all fuels and from water power, the ideal factor for converting water power into fuel equivalent would be the average efficiency of all forms of fuel consumption in each year. No basis for determining such an all-embracing average exists at present but enough is known to be certain that it would show much less reduction from 1899 to 1936 than did the central stations. For the present, a just comparison of the changing contributions of water power and of fuel to the national energy supply would lie somewhere between the results shown by the *constant* equivalent and the *prevailing central-station* equivalent in these tables.

As in earlier issues of these tables, the figures for oil and natural gas represent the entire production of crude petroleum and of gas. Most of this production does not come into direct competition with coal. Much of the supply of both oil and gas is used in regions of the country, such as California and portions of the Southwest, where coal is available only at unusually high cost because of heavy transport charges. Nearly half of the natural gas is used in the field for drilling or operating oil and gas wells and pipe lines, or for the manufacture of carbon black. More than half the oil is used in the form of gasoline, kerosene, and lubricants, for which purposes coal cannot well compete, except at very much higher levels of oil prices. Even these refined products, however, involve a certain measure of indirect competition with coal, for the energy market of the country is becoming more fluid and competitive, and a demand which cannot be met by one source of supply tends to fall back on the others.

The subject of interfuel competition is exceedingly complex, and it would require an elaborate analysis and the accumulation of data not now available to determine even approximately how much of any one fuel has actually been displaced either by other fuels or by water power. The present tables do not permit determination of such displacement; their purpose is rather to measure the long-time trends in the total demand for energy.

[8] Tryon, F. G. and Rogers, H. O., Statistical Studies of Progress in Fuel Efficiency: Trans., 2d World Power Conference, 1930. From 1917 to 1935 the average saving in unit fuel consumption of electric central stations was 58.5 percent, as against 29.6 percent for railroad freight service and 19.8 percent for iron blast furnaces.

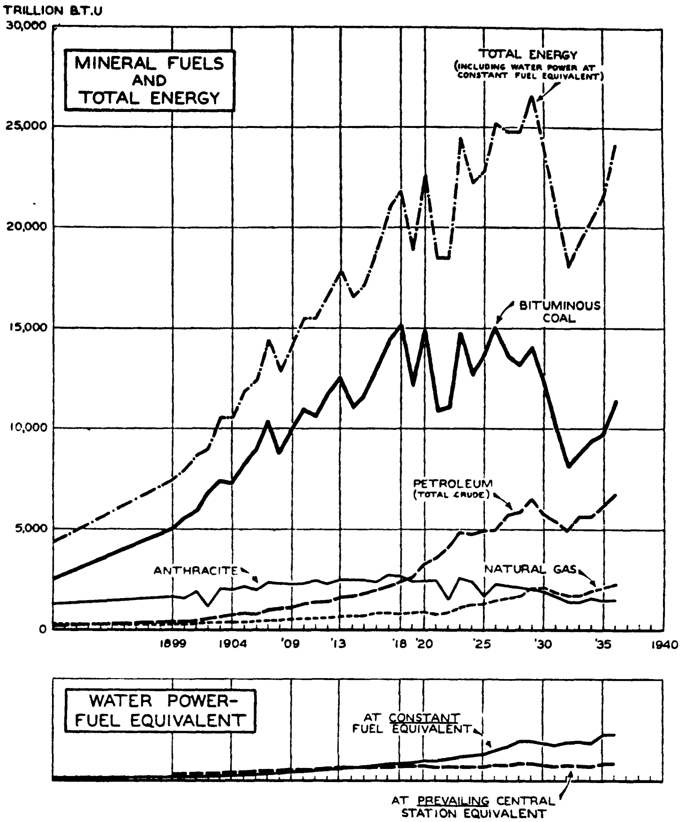


FIGURE 49.—Annual supply of energy from mineral fuels and water power in the United States, 1889–1936.

TABLE 8.—*Annual supply of energy from mineral fuels and water power in the United States, in trillions of B. t. u.*[1]

Year	Pennsylvania anthracite	Bituminous coal	Total coal	Petroleum (total crude, including that refined): Domestic production	Petroleum: Imports	Natural gas (total production)	Total petroleum and natural gas	Total mineral fuels	Water power (fuel equivalent): At constant fuel equivalent[2]	Water power: At prevailing central-station equivalent[3]	Grand total energy: Water power at constant fuel equivalent	Grand total energy: Water power at prevailing central-station equivalent
1889	1,239	2,507	3,746	211	------	[4] 268	479	4,225	91	No data	4,316	No data
1899	1,643	5,065	6,708	342	------	[4] 240	582	7,291	135	238	7,426	7,529
1900	1,560	5,563	7,123	382	------	[4] 254	636	7,759	146	250	7,905	8,009
1901	1,835	5,917	7,752	416	------	[4] 283	699	8,451	159	264	8,610	8,715
1902	1,125	6,818	7,943	533	------	[4] 301	834	8,777	179	289	8,956	9,066
1903	2,029	7,408	9,437	603	------	[4] 319	922	10,359	206	321	10,565	10,680
1904	1,990	7,301	9,291	702	------	[4] 333	1,035	10,326	235	354	10,561	10,680
1905	2,112	8,255	10,367	808	------	[4] 377	1,185	11,552	265	386	11,817	11,938
1906	1,939	8,983	10,922	759	------	418	1,177	12,099	294	414	12,393	12,513
1907	2,328	10,343	12,671	997	------	437	1,434	14,105	325	441	14,430	14,546
1908	2,265	8,713	10,978	1,071	------	432	1,503	12,481	365	476	12,846	12,957
1909	2,205	9,949	12,155	1,099	(5)	517	1,616	13,771	411	513	14,182	14,284
1910	2,298	10,928	13,226	1,257	3	547	1,807	15,033	453	539	15,486	15,572

See footnotes at end of table.

TABLE 8.—*Annual supply of energy from mineral fuels and water power in the United States, in trillions of B. t. u.*—Continued

Year	Pennsylvania anthracite	Bituminous coal	Total coal	Petroleum (total crude, including that refined)		Natural gas (total production)	Total petroleum and natural gas	Total mineral fuels	Water power (fuel equivalent)		Grand total energy	
				Domestic production	Imports				At constant fuel equivalent	At prevailing central-station equivalent	Water power at constant fuel equivalent	Water power at prevailing central-station equivalent
1911	2,461	10,635	13,096	1,323	9	551	1,883	14,979	496	565	15,475	15,544
1912	2,295	11,793	14,088	1,338	41	604	1,983	16,071	538	585	16,609	16,656
1913	2,490	12,535	15,025	1,491	102	626	2,219	17,243	588	609	17,831	17,852
1914	2,470	11,075	13,545	1,595	101	636	2,332	15,877	640	636	16,517	16,513
1915	2,421	11,597	14,018	1,687	109	676	2,472	16,490	694	659	17,184	17,149
1916	2,382	13,166	15,548	1,805	125	810	2,740	18,288	750	681	19,038	18,969
1917	2,709	14,457	17,166	2,012	181	855	3,048	20,214	806	700	21,020	20,914
1918	2,688	15,180	17,868	2,136	226	775	3,137	21,005	837	701	21,842	21,706
1919	2,396	12,206	14,602	2,270	317	802	3,389	17,991	892	718	18,883	18,709
1920	2,437	14,899	17,336	2,658	637	858	4,153	21,489	971	738	22,460	22,227
1921	2,461	10,897	13,358	2,833	752	712	4,297	17,655	908	620	18,563	18,275
1922	1,487	11,063	12,551	3,345	764	820	4,929	17,480	1,024	643	18,504	18,123
1923	2,539	14,792	17,331	4,394	492	1,083	5,969	23,300	1,136	685	24,436	23,985
1924	2,392	12,672	15,064	4,284	467	1,228	5,978	21,042	1,167	648	22,209	21,690
1925	1,681	13,625	15,306	4,582	371	1,278	6,231	21,537	1,290	668	22,827	22,205
1926	2,297	15,022	17,319	4,625	362	1,411	6,398	23,717	1,492	728	25,209	24,445
1927	2,179	13,565	15,744	5,407	350	1,553	7,310	23,054	1,687	776	24,741	23,830
1928	2,049	13,120	15,169	5,409	479	1,686	7,574	22,743	1,942	854	24,685	23,597
1929	2,008	14,017	16,025	6,044	474	2,062	8,580	24,605	1,929	816	26,534	25,421
1930	1,887	12,249	14,136	5,388	373	2,089	7,850	21,986	1,856	752	23,842	22,738
1931	1,622	10,011	11,633	5,106	284	1,813	7,203	18,836	1,721	668	20,557	19,504
1932	1,356	8,114	9,470	4,711	268	1,673	6,652	16,122	1,900	713	18,022	16,835
1933	1,348	8,741	10,089	5,434	191	1,672	7,297	17,386	1,931	711	19,317	18,097
1934	1,555	9,415	10,970	5,448	213	1,904	7,565	18,535	1,896	698	20,431	19,233
1935	[6] 1,419	9,756	11,175	5,980	193	2,060	8,233	19,408	2,207	806	21,615	20,214
1936 [7]	[6] 1,489	11,373	12,862	6,591	194	2,231	9,016	21,878	2,256	812	24,134	22,690

[1] The unit heat values employed are: Anthracite, 13,600 B. t. u. per pound; bituminous coal, 13,100 B. t. u. per pound; petroleum, 6,000,000 B. t. u. per barrel; natural gas, 1,075 B. t. u. per cubic foot. Water power includes installations owned by manufacturing plants and mines, as well as Government and privately owned public utilities. The fuel equivalent of water power is calculated from the kilowatt-hours of power produced wherever available, as is true of all public-utility plants since 1919. Otherwise the fuel equivalent is calculated from the reported horsepower of installed water wheels, assuming a capacity factor of 20 percent for manufactures and mines and of 40 percent for public utilities.

[2] Assuming 4 pounds per kilowatt-hour, which is the average in round numbers of central electric-station practice in 1913, the midpoint of the period shown.

[3] Assuming the average central-station practice for each of the years shown, which declined from about 7.05 pounds per kilowatt-hour in 1899 to 1.44 pounds in 1936.

[4] Based on the amount of coal displaced by gas as estimated by the gas companies at the time.

[5] Imports negligible.

[6] Does not include an unknown amount of bootleg or stolen coal. If this were included, the energy for anthracite would be approximately 1,528 trillion B. t. u. in 1935 and 1,598 trillion B. t. u. in 1936, and the total energy would be increased accordingly.

[7] Preliminary.

Table 9 compares the relative increase in the several sources of energy by means of index numbers in which production for the year 1918 is represented by 100. Production of anthracite in 1936 was 45 percent below 1918 (41 percent if bootleg coal is included). Production of bituminous coal was 25 percent below 1918. Production of domestic petroleum increased 209 percent over 1918, and natural gas increased 188 percent.

There was an increase of 170 percent in the amount of water power developed (represented by the constant fuel equivalent).

TABLE 9.—*Relative rate of growth of coal, oil, and water power in the United States*

[The figures for the year 1918 are represented by the number 100, and the figures for all other years are expressed as a percentage of the 1918 rate]

Year	Pennsylvania anthracite	Bituminous coal	Total coal	Petroleum (total crude)		Natural gas (total production)	Total oil and gas	Water power (at constant fuel equivalent)	Grand total	
				Domestic production	Imports				With water power at constant fuel equivalent	With water power at prevailing central station equivalent
1889	46	17	21	10	----------	35	15	11	20	(1)
1899	61	33	37	16	----------	31	19	16	34	35
1904	74	48	52	33	----------	43	33	28	48	49
1909	82	66	68	51	(2)	67	52	49	65	66
1913	93	83	84	70	45	81	71	70	82	82
1918	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1919	89	80	81	106	140	103	108	107	86	86
1920	91	98	97	124	282	111	132	116	103	102
1921	92	72	74	132	333	92	137	109	85	84
1922	55	73	70	156	338	106	157	122	85	83
1923	94	97	97	206	218	140	191	136	112	110
1924	89	83	84	201	207	158	191	139	102	100
1925	63	90	86	215	164	165	199	154	105	102
1926	85	99	97	217	160	182	204	178	115	113
1927	81	89	88	253	155	201	233	202	113	110
1928	76	86	85	253	212	218	241	232	113	109
1929	75	92	90	283	210	266	274	230	121	117
1930	70	81	79	252	165	270	250	222	109	105
1931	60	66	65	239	126	234	230	206	94	90
1932	50	53	53	221	119	216	212	227	83	78
1933	50	57	56	252	90	205	229	231	87	83
1934	58	62	61	255	94	246	241	227	94	89
1935	[3] 53	64	63	280	85	266	262	264	99	93
1936 [4]	[3] 55	75	72	309	86	288	287	270	110	105

[1] Not available.
[2] Imports negligible.
[3] If illicit or bootleg anthracite were included, the index for 1935 would be 57 and that for 1936, 59.
[4] Preliminary.

Table 10 gives the percentage composition of the total energy supply, on the alternative assumptions of water power at constant and at prevailing central-station equivalents in fuel. (See fig. 50.) On the assumption of constant equivalent, the proportion contributed by water power has increased from 1.8 percent in 1899 to 9.3 in 1936. On the assumption of prevailing central-station equivalent, it has remained substantially unchanged at between 3 and 4 percent. As already noted, the truth lies somewhere between the two assumptions. On either basis, water power furnishes a relatively small fraction of the total energy budget of the Nation, although, of course, a much larger fraction of the electric power produced by public utilities.

Coal remained the largest source of energy in 1936, contributing 53.3 percent with water power counted at constant fuel equivalent and 56.7 percent with water power at prevailing central-station equivalent.

TABLE 10.—*Percent of total B. t. u. equivalent contributed by the several mineral fuels and water power in the United States*

Year	Pennsylvania anthracite	Bituminous coal	Total coal	Petroleum (total crude)		Natural gas (total production)	Total oil and gas	Total mineral fuels	Water power, fuel equivalent	Grand total, including water power
				Domestic production	Imports					
	Water power counted at *constant* fuel equivalent of 4 lb. per kilowatt-hour									
1889	28.7	58.1	86.8	4.9	---------	6.2	11.1	97.9	2.1	100.0
1899	22.1	68.2	90.3	4.6	---------	3.3	7.9	98.2	1.8	100.0
1909	15.5	70.2	85.7	7.7	(1)	3.7	11.4	97.1	2.9	100.0
1913	14.0	70.3	84.3	8.3	0.6	3.5	12.4	96.7	3.3	100.0
1918	12.3	69.5	81.8	9.8	1.0	3.6	14.4	96.2	3.8	100.0
1920	10.9	66.3	77.2	11.8	2.9	3.8	18.5	95.7	4.3	100.0
1921	13.3	58.7	72.0	15.2	4.1	3.8	23.1	95.1	4.9	100.0
1922	8.0	59.8	67.8	18.1	4.1	4.4	26.6	94.4	5.6	100.0
1923	10.4	60.5	70.9	18.0	2.0	4.5	24.5	95.4	4.6	100.0
1925	7.4	59.6	67.0	20.1	1.6	5.6	27.3	94.3	5.7	100.0
1926	9.1	59.6	68.7	18.4	1.4	5.6	25.4	94.1	5.9	100.0
1927	8.8	54.8	63.6	21.9	1.4	6.3	29.6	93.2	6.8	100.0
1928	8.3	53.2	61.5	21.9	2.0	6.8	30.7	92.2	7.8	100.0
1929	7.6	52.8	60.4	22.8	1.8	7.7	32.3	92.7	7.3	100.0
1930	7.9	51.4	59.3	22.5	1.6	8.8	32.9	92.2	7.8	100.0
1931	7.9	48.7	56.6	24.8	1.4	8.8	35.0	91.6	8.4	100.0
1932	7.5	45.0	52.5	26.1	1.5	9.3	36.9	89.4	10.6	100.0
1933	7.0	45.2	52.2	28.1	1.0	8.7	37.8	90.0	10.0	100.0
1934	7.6	46.1	53.7	26.7	1.0	9.3	37.0	90.7	9.3	100.0
1935	[2] 6.6	45.1	51.7	27.7	.9	9.5	38.1	89.8	10.2	100.0
1936 [3]	[2] 6.2	47.1	53.3	27.3	.8	9.3	37.4	90.7	9.3	100.0
	Water power counted at *prevailing* central-station equivalent for year									
1899	21.8	67.3	89.1	4.5	---------	3.2	7.7	96.8	3.2	100.0
1909	15.4	69.7	85.1	7.7	---------	3.6	11.3	96.4	3.6	100.0
1913	13.9	70.3	84.2	8.3	0.6	3.5	12.4	96.6	3.4	100.0
1918	12.4	69.9	82.3	9.9	1.0	3.6	14.5	96.8	3.2	100.0
1920	11.0	67.0	78.0	12.0	2.9	3.8	18.7	96.7	3.3	100.0
1921	13.5	59.6	73.1	15.5	4.1	3.9	23.5	96.6	3.4	100.0
1922	8.2	61.1	69.3	18.5	4.2	4.5	27.2	96.5	3.5	100.0
1923	10.6	61.6	72.2	18.3	2.1	4.5	24.9	97.1	2.9	100.0
1925	7.6	61.3	68.9	20.6	1.7	5.8	28.1	97.0	3.0	100.0
1926	9.4	61.4	70.8	18.9	1.5	5.8	26.2	97.0	3.0	100.0
1927	9.1	56.9	66.0	22.7	1.5	6.5	30.7	96.7	3.3	100.0
1928	8.7	55.6	64.3	22.9	2.0	7.2	32.1	96.4	3.6	100.0
1929	7.9	55.1	63.0	23.8	1.9	8.1	33.8	96.8	3.2	100.0
1930	8.3	53.9	62.2	23.7	1.6	9.2	34.5	96.7	3.3	100.0
1931	8.3	51.3	59.6	26.2	1.5	9.3	37.0	96.6	3.4	100.0
1932	8.1	48.2	56.3	28.0	1.6	9.9	39.5	95.8	4.2	100.0
1933	7.4	48.4	55.8	30.0	1.1	9.2	40.3	96.1	3.9	100.0
1934	8.1	49.0	57.1	28.3	1.1	9.9	39.3	96.4	3.6	100.0
1935	[2] 7.0	48.3	55.3	29.5	1.0	10.2	40.7	96.0	4.0	100.0
1936 [3]	[2] 6.6	50.1	56.7	29.0	.9	9.8	39.7	96.4	3.6	100.0

[1] Less than 0.1 percent.
[2] If bootleg coal were included the proportion from anthracite would be 7.0 percent in 1935 and 6.6 in 1936 at *constant* and 7.5 in 1935 and 7.0 in 1936 at *prevailing* water power equivalents.
[3] Preliminary.

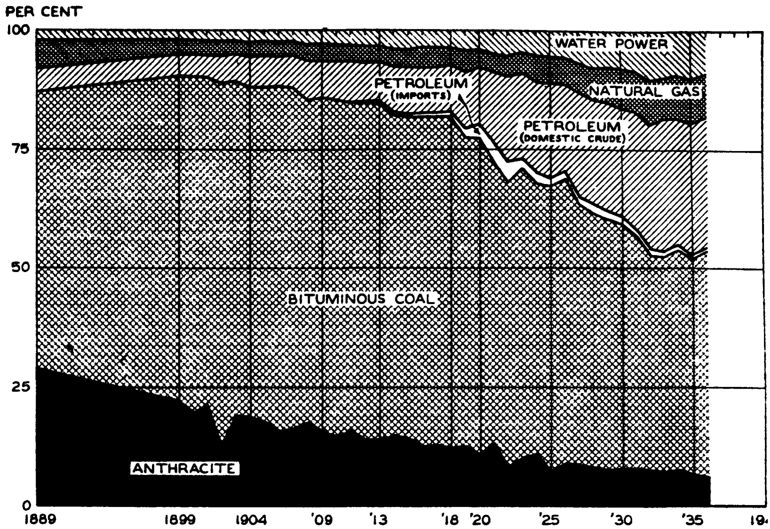


FIGURE 50.—Percent of total B. t. u. equivalent contributed by the several sources of energy, counting water power at constant fuel equivalent, 1889–1936.

If water power is counted at the prevailing fuel equivalent of central stations in each year, its proportion is 3.2 percent in 1899 and 3.6 percent in 1936, and the proportions of the other sources of energy are affected accordingly.

FINAL BITUMINOUS STATISTICS FOR 1935

Tables 11 to 47 give the final detailed statistics of bituminous mine operations in 1935. The subjects covered include production, number and size of mines, employment and length of working day, equipment and methods of preparation, fuel economy, stocks, shipments by railroads and waterways, foreign trade, and world production.

The data have been released for immediate use through the Weekly Coal Report as rapidly as the tabulations could be completed. A summary of all the major tables was issued in mimeographed form February 10, 1937 (Bituminous Coal Tables, 1935–36).

Corresponding data regarding expenditures for supplies and materials, colliery fuel, purchased electric power, salaries, and wages were collected by the Bureau of Mines in cooperation with the Census Bureau as a feature of the Census of Business for 1935. These data have been previously released in multigraphed statements by the Census Bureau and are brought together in permanent form in a report published by the Works Progress Administration under the title "Employment and Related Statistics of Mines and Quarries, 1935—Part I, Bituminous Coal."

PRODUCTION

SUMMARY BY STATES

TABLE 11.—*Summary of coal produced, value, men employed, days operated, and output per man per day, by States, in 1935*

[Exclusive of product of wagon mines producing less than 1,000 tons.[1] For notes as to certain estimates included in totals of value of product, and as to comparability of 1935 figures of employment in Illinois, Indiana, and Pennsylvania, with those for 1934, see detailed tables by States]

State	Net tons					Value		Number of employees				Average number of days mines operated	Man-days of labor[2] (in thousands)	Average tons per man per day[2]
	Loaded at mines for shipment by rail or water	Commercial sales by truck or wagon	Other sales to local trade or used by employees or taken by locomotives at tipple	Used for power and heat or made into coke at mines[3]	Total quantity	Total (thousand dollars)	Average per ton	Underground	Surface: In strip pits	Surface: All others	Total			
Alabama	8,089,737	268,009	86,783	59,981	8,504,510	18,251	$2.15	16,190	152	2,564	18,906	161	3,043	2.79
Alaska	112,260		5,971	1,194	119,425	502	4.20	60		35	95	249	24	5.05
Arizona, California, Idaho, and Oregon	7,472	8,420	7,932	1,020	24,844	95	3.82	82		21	103	140	14	1.72
Arkansas	1,110,787	8,230	2,383	11,879	1,133,279	3,448	3.04	3,218	42	483	3,743	123	459	2.47
Colorado	4,379,481	1,169,675	149,975	[3] 211,380	5,910,511	13,675	2.31	6,820	20	1,313	8,153	177	1,447	4.08
Georgia and North Carolina	19,719	2,600	120	295	22,734	58	2.55	90		19	109	160	17	1.30
Illinois	37,154,075	6,050,159	609,102	712,133	44,525,469	69,516	1.56	35,271	2,132	6,345	43,748	171	7,460	5.97
Indiana	14,098,465	976,602	452,132	227,015	15,754,214	23,722	1.51	7,281	2,037	2,029	11,347	176	1,992	7.91
Iowa	2,059,149	1,502,268	53,654	35,092	3,650,163	9,002	2.47	6,998	223	817	8,038	162	1,306	2.80
Kansas	2,368,581	303,004	4,504	10,075	2,686,164	4,943	1.84	2,396	990	510	3,896	173	672	4.00
Kentucky	39,393,354	727,664	372,272	267,649	40,760,939	65,956	1.62	44,847	15	7,477	52,339	182	9,520	4.28
Maryland	1,404,096	243,979	20,768	9,216	1,678,059	3,266	1.95	2,611		351	2,962	179	529	3.17
Michigan	263,628	322,653	12,959	29,144	628,384	2,017	3.21	1,227	34	206	1,467	158	232	2.70
Missouri	2,896,101	660,236	65,772	23,887	3,645,996	6,924	1.90	4,068	863	779	5,710	159	907	4.02
Montana	2,585,818	158,579	11,174	3,335	2,758,906	4,146	1.50	1,170	56	345	1,571	189	297	9.30
New Mexico	1,263,778	62,689	22,905	39,505	1,388,877	3,681	2.65	1,891		464	2,355	185	435	3.19
North Dakota	1,435,934	437,079	74,329	8,168	1,955,510	2,395	1.22	668	424	273	1,365	188	257	7.61
Ohio	17,867,820	2,707,083	455,383	122,865	21,153,151	35,111	1.66	25,369	871	3,284	29,524	162	4,768	4.44
Oklahoma	1,148,474	60,028	7,878	13,018	1,229,398	2,879	2.34	2,491	199	461	3,151	122	385	3.19
Pennsylvania	81,953,364	4,679,156	3,235,652	[3] 1,536,498	91,404,670	172,170	1.88	108,788	399	14,922	124,109	180	22,307	4.10
South Dakota	1,862	11,241	95	45	13,243	21	1.59	21	18	16	55	98	5	2.46
Tennessee	3,886,133	150,478	45,279	[3] 55,912	4,137,802	7,435	1.80	6,292		1,239	7,531	181	1,362	3.04
Texas	716,214	32,008	1,575	7,732	757,529	654	.86	658	28	106	792	177	140	5.42
Utah	2,808,321	101,064	19,811	[3] 17,722	2,946,918	6,091	2.07	2,063		689	2,752	188	517	5.70
Virginia	9,260,079	79,805	70,950	[3] 256,184	9,667,018	17,128	1.77	11,033		2,010	13,043	189	2,468	3.92

Washington	1, 167, 303	351, 208	21, 038	[2] 19, 657	1, 559, 206	4, 686	3. 01	1, 755		503	2, 258	192	433	3. 60
West Virginia	95, 809, 219	733, 122	1, 897, 796	[2] 738, 924	99, 179, 061	169, 164	1. 71	93. 483	2	15, 830	109, 315	192	20, 945	4. 74
Wyoming	4, 807, 434	153, 213	65, 427	151, 068	5, 177, 142	11, 127	2. 15	3, 101	28	837	3, 966	217	862	6. 00
Total 1935	339, 068, 658	21, 960, 252	7, 773, 619	[2] 4, 570, 593	372, 373. 122	658, 063	1. 77	389, 942	8, 533	63, 928	462, 403	179	82, 803	4. 50
Total 1934	328, 431, 697	18, 739, 320	7, 374, 143	[2] 4, 822, 862	359, 368, 022	628, 383	1. 75	384, 947	7, 652	65, 412	458, 011	178	81, 724	4. 40

[1] The figures relate only to active bituminous-coal mines of commercial size that produced coal in 1935, excluding wagon mines producing less than 1,000 tons.

[2] Includes coal made into coke at mines in the following States in 1935: Colorado, 75,810 tons; Pennsylvania, 878,144; Tennessee, 6,047; Utah, 11,808; Virginia, 235,498; Washington, 3,978; West Virginia, 256,617; a grand total of 1,467,902 tons in 1935, against 1,647,805 in 1934.

[3] Based upon (1) the "reported" number of man-shifts where the operator keeps a record thereof, otherwise upon (2) the "calculated" number of man-shifts obtained by multiplying the average number of men employed underground and on the surface at each mine by the number of days worked by the mine and tipple, respectively. Using throughout the "calculated" man-shifts as developed before the year 1932, namely, the product of the total number of men employed at each mine times the tipple days, the average output per man per day was 4.56 in 1935, a figure strictly comparable with 5.06 in 1930, previously published.

TOTAL PRODUCTION SINCE BEGINNING OF MINING

TABLE 12.—*Coal produced, by States, 1925–35, with production of maximum year and cumulative production from the earliest record to the end of 1935, in thousands of net tons*

State	Maximum production		Production by years											Total production from earliest record to end of 1935
	Year	Quantity	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	
Alabama	1926	21,001	20,004	21,001	19,766	17,621	17,944	15,570	11,999	7,857	8,760	9,142	8,505	603,297
Arkansas	1907	2,670	1,220	1,459	1,549	1,661	1,695	1,533	1,154	1,033	883	857	1,133	69,210
Colorado	1917	12,483	10,311	10,637	9,724	9,848	9,921	8,197	6,604	5,599	5,230	5,211	5,911	377,260
Georgia	1903	416	66	(1)	77	58	45	7	22	27	41	33	(1)	(1)
Illinois	1918	89,291	66,909	69,367	46,848	55,948	60,658	53,731	44,303	33,475	37,413	41,272	44,525	2,303,362
Indiana	1918	30,679	21,225	23,186	17,936	16,379	18,344	16,490	14,295	13,324	13,761	14,794	15,754	685,503
Iowa	1917	8,966	4,715	4,625	2,950	3,684	4,241	3,893	3,388	3,862	3,195	3,367	3,650	301,141
Kansas	1918	7,562	4,524	4,416	3,444	2,810	2,976	2,430	1,987	1,953	2,218	2,508	2,686	223,227
Kentucky	1927	69,124	55,069	62,924	69,124	61,860	60,463	51,209	39,964	35,300	36,100	38,525	40,761	1,115,361
Maryland	1907	5,533	2,695	3,078	2,815	2,687	2,649	2,271	2,006	1,429	1,531	1,627	1,678	236,694
Michigan	1907	2,036	808	687	757	617	805	661	359	446	407	622	628	42,728
Missouri	1917	5,671	2,694	3,008	3,064	3,733	4,030	3,853	3,621	4,070	3,432	3,352	3,646	204,210
Montana	1918	4,533	3,044	2,798	3,144	3,324	3,408	3,022	2,378	2,125	2,152	2,566	2,759	109,115
New Mexico	1918	4,023	2,557	2,818	2,935	2,712	2,623	1,969	1,553	1,263	1,226	1,259	1,389	101,458
North Carolina	1922	79	65	(1)	53	61	52	29	2	2	2	3	(1)	(1)
North Dakota	1935	1,956	1,325	1,370	1,528	1,650	1,862	1,700	1,519	1,740	1,782	1,754	1,956	33,357
Ohio	1920	45,878	28,034	27,872	15,800	15,641	23,689	22,552	20,411	13,909	19,589	20,691	21,153	1,286,259
Oklahoma	1920	4,849	2,326	2,843	3,818	3,501	3,774	2,794	1,908	1,255	1,238	1,208	1,229	125,890
Pennsylvania bituminous	1918	178,551	136,928	153,042	132,965	131,202	143,516	124,463	97,659	74,776	79,296	89,826	91,405	5,667,297
Tennessee	1910	7,121	5,454	5,789	5,783	5,611	5,405	5,130	4,721	3,538	3,775	4,136	4,138	239,876
Texas	1913	2,429	1,008	1,091	1,326	1,182	1,101	834	716	637	822	759	758	55,610
Utah	1920	6,005	4,690	4,374	4,781	4,843	5,161	4,258	3,350	2,852	2,675	2,406	2,947	124,547
Virginia	1926	14,133	12,800	14,133	12,916	11,901	12,748	10,907	9,699	7,692	8,179	9,377	9,667	323,617
Washington	1918	4,082	2,538	2,587	2,635	2,520	2,521	2,302	1,846	1,591	1,394	1,383	1,559	121,297
West Virginia	1927	145,122	122,381	143,509	145,122	132,952	138,519	121,473	101,473	85,609	94,344	98,134	99,179	3,013,759
Wyoming	1920	9,630	6,553	6,512	6,754	6,572	6,705	6,088	4,994	4,171	4,013	4,368	5,177	263,957
Other States			110	241	149	167	134	160	158	175	173	188	180	61,038
Total bituminous			520,053	573,367	517,763	500,745	534,989	467,526	382,089	309,710	333,631	359,368	372,373	17,689,070
Pennsylvania anthracite	1917	99,612	61,817	84,437	80,096	75,348	73,828	69,385	59,646	49,855	49,541	57,168	52,159	4,129,922
Grand total			581,870	657,804	597,859	576,093	608,817	536,911	441,735	359,565	383,172	416,536	424,532	21,818,992

[1] Included under "Other States."

PRODUCTION BY FIELDS

TABLE 13.—*Bituminous coal produced, number of mines active, men employed, days operated, and output per man per day in the several fields adopted by the United States Coal Commission, 1935*

[The definitions of these fields are given in detail on pp. 2034–2052, part IV, of the report of the United States Coal Commission]

United States Coal Commission field number	State	General name of field	1935: Number of mines	1935: Production (net tons)	1935: Number of men	1935: Average number of days mines operated	1935: Average tons per man per day
1	Pennsylvania	Pittsburgh	228	25,888,000	30,729	197	4.28
2	do	Connellsville	101	14,740,000	17,828	181	4.58
3	do	Westmoreland-Ligonier	79	6,008,000	7,953	165	4.57
4-a-b	do	Freeport (thick and thin)	73	8,824,000	9,269	189	5.04
5	do	Butler-Mercer	63	1,167,000	2,415	176	2.74
6	do	Blossburg	23	263,000	697	174	2.17
7	do	Broad Top	45	1,050,000	2,134	170	2.90
8	do	Somerset	88	3,525,000	5,095	187	3.69
9-a	do	Central Pennsylvania, Western.	74	1,807,000	3,612	147	3.41
9-b	do	Central Pennsylvania, Middle	84	6,712,000	9,892	169	4.01
9-c	do	Central Pennsylvania, Eastern.	507	21,421,000	34,485	171	3.62
10	Maryland-West Virginia.	Maryland-Potomac	142	2,708,000	4,590	181	3.26
11	West Virginia	Fairmont	100	14,710,000	15,539	163	5.79
12	Ohio-West Virginia.	Panhandle-Pittsburgh No. 8	141	14,530,000	16,552	180	4.87
13	do	Pomeroy	33	404,000	881	133	3.44
14	West Virginia	Putnam County	3	439,000	609	195	3.69
15	Kentucky-West Virginia.	Kenova	14	1,667,000	1,800	182	5.08
16	Kentucky - Virginia - West Virginia.	Thacker (including Buchanan County, Virginia.)	44	6,496,000	6,989	188	4.94
17	West Virginia	Tug River	28	6,284,000	7,065	217	4.09
18	Virginia - West Virginia.	Pocahontas	72	16,622,000	17,631	190	4.96
19	West Virginia	Winding Gulf	54	8,902,000	9,720	213	4.29
20	do	New River	98	11,517,000	13,859	202	4.12
21	do	Kanawha	89	15,038,000	16,595	207	4.39
22	do	Coal River	5	1,106,000	1,146	178	5.42
23	do	Logan	65	12,790,000	11,810	183	5.92
24-a	do	Coal and Coke	12	708,000	868	227	3.59
24-b	do	Preston County	33	539,000	1,081	129	3.88
24-c	do	Taylor County, Junior, Philippi, and Gauley.	85	3,592,000	5,076	155	4.56
25	Virginia	Southwestern Virginia	45	5,111,000	6,811	194	3.87
26	do	Clinch Valley	16	1,712,000	2,516	194	3.50
27	do	Virginia "anthracite"	6	187,000	624	163	1.84
28	do	Richmond Basin	-----	-----	-----	-----	-----
29	Ohio	Massillon-Palmyra-Lisbon	128	1,796,000	2,884	170	3.67
30	do	Coshocton-Goshen	197	2,053,000	2,971	171	4.03
31	do	Cambridge	38	1,381,000	2,210	159	3.94
32	do	Crooksville	65	1,063,000	1,518	172	4.06
33	do	Hocking	108	3,202,000	6,175	130	3.99
34	do	Jackson and Ironton	74	628,000	1,096	151	3.80
36	Kentucky	Northeast Kentucky [1]	82	9,769,000	12,673	197	3.92
37	do	Hazard [2]	53	4,616,000	6,222	172	4.31
38	do	Harlan	55	12,166,000	12,604	224	4.31
39	Kentucky-Tennessee.	Southern Appalachian	129	4,330,000	8,222	158	3.32
40	do	Jellico	20	494,000	1,163	132	3.22
41	Kentucky	Western Kentucky	182	8,134,000	11,711	143	4.87
42	Tennessee	Rockwood-Soddy	50	1,548,000	3,034	194	2.63
43	do	Fentress	9	334,000	469	186	3.83
44	Alabama	Big Seam Group	27	3,159,000	5,833	168	3.22
45	Alabama-Georgia.	Cahaba Group [3]	96	2,835,000	7,326	168	2.30
46	Alabama	Pratt Group	43	2,534,000	5,856	145	2.99
47	Indiana	Indiana	158	14,775,000	10,629	174	7.97
48	do	Brazil Block	30	979,000	718	193	7.06
49	Illinois	Northern Illinois	66	1,907,000	2,506	180	4.22
50	do	Fulton-Peoria	205	5,185,000	4,982	187	5.58
51	do	Danville	76	2,014,000	2,546	181	4.38

TABLE 13.—*Bituminous coal produced, number of mines active, men employed, days operated, and output per man per day in the several fields adopted by the United States Coal Commission, 1935*—Continued

[The definitions of these fields are given in detail on pp. 2034-2052, part IV, of the report of the United States Coal Commission]

United States Coal Commission field number	State	General name of field	1935: Number of mines	1935: Production (net tons)	1935: Number of men	1935: Average number of days mines operated	1935: Average tons per man per day
52	do	Central Illinois	96	11,874,000	10,999	180	5.98
53	do	Belleville	105	5,660,000	6,243	149	6.07
54	do	Murphysboro	11	234,000	210	144	7.73
55	do	Southern Illinois	163	17,651,000	16,262	164	6.61
56	Michigan	Michigan	20	628,000	1,467	158	2.70
57	Arkansas	Sebastian	28	513,000	1,490	126	2.74
58	do	Excelsior-Logan	23	422,000	1,363	133	2.34
59	do	Arkansas "anthracite"	14	198,000	890	102	2.18
60	Colorado	Colorado "domestic"	167	2,608,000	3,953	173	3.81
61	do	Trinidad	33	953,000	1,522	157	3.99
62	do	Northern Colorado	63	2,350,000	2,678	195	4.50
63	Iowa	Marion-Monroe-Polk	184	2,555,000	5,108	165	3.03
64	do	Appanoose	79	1,095,000	2,930	158	2.36
65	Kansas	Pittsburg	115	2,470,000	2,721	160	5.69
66	do	Lightning Creek					
67	do	Osage	60	137,000	676	128	1.58
68	do	Leavenworth [4]	4	112,000	652	268	.64
69	Missouri	Southern Missouri	87	2,780,000	2,172	182	7.04
70	do	Lafayette	112	833,000	3,385	145	1.70
71	do	Grundy	(4)	(4)	(4)	(4)	(4)
72	do	Platte	(4)	(4)	(4)	(4)	(4)
73	Montana	Montana	81	2,759,000	1,571	189	9.30
74	New Mexico	Gallup	18	623,000	1,163	180	2.97
75	do	Cerrillos and Carthage	7	124,000	345	237	1.51
76	do	Raton	14	609,000	781	165	4.71
76-a	do	Monero	10	33,000	66	216	2.32
77	North Dakota	Southern North Dakota	94	1,088,000	869	178	7.05
78	do	Northern North Dakota	67	868,000	496	207	8.46
79	Oklahoma	McAlester Vein	15	162,000	431	162	2.31
80	do	Oklahoma, Eastern	89	1,067,000	2,720	116	3.39
81	Texas	Texas (bituminous)	4	36,000	266	150	.90
82	do	Texas (lignite)	14	722,000	526	190	7.22
83	Utah	Utah	40	2,947,000	2,752	188	5.70
84	Washington	Kittitas County	13	628,000	731	215	4.00
85	do	Pierce-King (bituminous)	17	391,000	689	199	2.85
86	do	Subbituminous	26	540,000	838	166	3.88
87	Wyoming	Wyoming	68	5,177,000	3,966	217	6.00
88	South Dakota	South Dakota	17	13,000	55	98	2.46
89	Oregon	Oregon	(5)	(5)	(5)	(5)	(5)
90	California	California [5]	10	17,000	85	108	1.84
91	Nevada	Nevada					
92	North Carolina	North Carolina	(3)	(3)	(3)	(3)	(3)
	Unclassified		6	127,000	113	256	4.39
			[6] 6,315	372,373,000	462,403	179	4.50

[1] Northeastern Kentucky field includes McRoberts district.
[2] Hazard field includes Whitesburg district.
[3] Cahaba Group includes North Carolina (no. 92) to avoid disclosure.
[4] Leavenworth field, Kansas, includes Grundy field, Missouri (no. 71) and Platte field, Missouri (no. 72).
[5] California includes Arizona, Idaho, and Oregon.
[6] As in 1934, the 1935 figures of total number of mines are not comparable with years before 1934 in a number of States because of more complete coverage of small trucking mines made possible by cooperation of the Divisional Code Authorities. See Minerals Yearbook, 1936, pp. 561-564.

PRODUCTION, BY WEEKS AND MONTHS

The following tables summarize the statistics of weekly and monthly production of bituminous coal first published in the Bureau of Mines Weekly Coal Reports. The figures are estimates based upon daily and weekly statements of cars of coal and beehive coke loaded by the principal railroads and of shipments over the Monongahela, Allegheny, Ohio, and Kanawha Rivers. The estimates are revised afterward to

agree with the results of the annual statistical reports from the coal producers; therefore the figures given here differ slightly from the estimates originally issued in the weekly reports.

For the method used in counting holidays see Coal in 1930, page 631.

TABLE 14.—*Estimated weekly production of bituminous coal in 1935*

Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)	Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)
Jan. 5	[1] 6,035,000	[1] 4.1	[2] 1,458,000	July 13	4,617,000	6	770,000
Jan. 12	7,908,000	6	1,318,000	July 20	5,529,000	6	922,000
Jan. 19	8,010,000	6	1,335,000	July 27	6,358,000	6	1,060,000
Jan. 26	8,512,000	6	1,419,000	Aug. 3	5,374,000	6	896,000
Feb. 2	8,755,000	6	1,459,000	Aug. 10	4,950,000	6	825,000
Feb. 9	8,833,000	6	1,472,000	Aug. 17	5,605,000	6	934,000
Feb. 16	8,790,000	6	1,465,000	Aug. 24	6,320,000	6	1,053,000
Feb. 23	8,545,000	5.9	1,448,000	Aug. 31	7,501,000	6	1,250,000
Mar. 2	8,979,000	6	1,497,000	Sept. 7	7,019,000	5	1,404,000
Mar 9	8,782,000	6	1,464,000	Sept. 14	8,480,000	6	1,413,000
Mar. 16	8,892,000	6	1,482,000	Sept. 21	7,804,000	6	1,301,000
Mar. 23	9,461,000	6	1,577,000	Sept. 28	1,715,000	6	286,000
Mar. 30	9,696,000	6	1,616,000	Oct. 5	7,104,000	6	1,184,000
Apr. 6	3,809,000	5.3	719,000	Oct. 12	8,491,000	6	1,415,000
Apr. 13	5,573,000	6	929,000	Oct. 19	8,355,000	6	1,393,000
Apr. 20	5,980,000	6	997,000	Oct. 26	8,388,000	6	1,398,000
Apr. 27	4,909,000	6	818,000	Nov. 2	7,948,000	6	1,325,000
May 4	5,023,000	6	837,000	Nov. 9	8,063,000	6	1,344,000
May 11	5,660,000	6	943,000	Nov. 16	7,934,000	5.5	1,443,000
May 18	5,872,000	6	979,000	Nov. 23	8,312,000	6	1,385,000
May 25	6,397,000	6	1,066,000	Nov. 30	7,575,000	5	1,515,000
June 1	6,799,000	5.3	1,283,000	Dec. 7	8,482,000	6	1,414,000
June 8	8,718,000	6	1,453,000	Dec. 14	8,370,000	6	1,395,000
June 15	9,296,000	6	1,549,000	Dec. 21	8,586,000	6	1,431,000
June 22	4,798,000	6	800,000	Dec. 28	6,966,000	5	1,393,000
June 29	6,515,000	6	1,086,000	Jan. 4	[1] 3,401,000	[1] 2	[2] 1,644,000
July 6	2,579,000	5	516,000				
				Total	372,373,000	306.1	1,217,000

[1] Figures represent output and number of working days in that part of the week included in the calendar year shown. Total production for the week of Jan. 5, 1935, was 7,435,000 net tons; for the week of Jan. 4, 1936, 8,385,000 net tons.

[2] Average daily production for the entire week and not for the working days in the calendar year shown.

TABLE 15.—*Monthly production of coal, by States, in 1935, in thousands of net tons*

[The totals for the year are based on final complete returns to the Bureau of Mines from all operators known to have produced more than 1,000 tons a year. The apportionment of the known yearly total among the 12 months is based on the best information available, in some States upon direct tonnage reports from operators to the State mine department; in most cases upon current records of railroad car loadings and waterway shipments]

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
Alaska	9	6	6	9	9	8	11	13	14	13	11	10	119
Alabama	877	939	1,003	677	806	804	612	698	612	73	436	968	8,505
Arkansas	158	96	54	21	27	37	53	89	128	190	138	142	1,133
Colorado	645	492	473	330	338	306	268	382	460	752	729	736	5,911
Illinois	5,174	4,677	5,191	2,051	2,607	3,114	2,027	2,465	2,955	4,885	4,247	5,132	44,525
Indiana	1,821	1,742	1,948	728	1,099	1,217	686	923	905	1,561	1,435	1,689	15,754
Iowa	499	416	473	116	261	269	163	147	226	334	330	416	3,650
Kansas	334	245	265	122	140	178	131	182	190	294	285	320	2,686
Kentucky: Eastern	2,925	2,887	2,949	2,200	2,528	2,663	2,228	2,494	2,461	3,493	3,023	2,776	32,627
Western	1,034	849	926	386	473	555	382	571	644	791	718	805	8,134
Maryland	187	175	190	107	92	140	75	115	107	175	149	166	1,678
Michigan	88	79	83	38	45	44	14	9	59	48	55	66	628
Missouri	435	364	383	160	212	250	169	214	274	411	359	415	3,646
Montana	281	207	236	186	184	168	160	189	216	330	334	268	2,759
New Mexico	129	108	118	99	104	103	92	107	95	138	155	141	1,389
North Dakota	309	148	129	82	71	50	57	67	143	344	305	251	1,956
Ohio	2,133	2,066	2,186	1,146	1,664	1,620	1,117	1,333	1,524	2,278	1,904	2,182	21,153
Oklahoma	177	89	60	43	36	54	39	71	128	204	167	161	1,229
Pennsylvania bituminous	8,599	8,683	10,180	5,677	6,964	8,285	5,962	6,816	5,763	8,422	7,821	8,233	91,405
Tennessee	438	457	463	253	351	325	295	342	303	129	372	410	4,138
Texas	70	65	64	53	57	53	60	65	65	68	71	67	758
Utah	361	233	253	171	127	142	110	139	177	410	441	393	2,947
Virginia	822	820	952	631	708	797	648	758	686	1,054	891	900	9,667
Washington	193	141	134	118	85	97	84	90	105	173	180	159	1,559
West Virginia: Southern [1]	6,614	6,467	6,962	5,001	5,620	6,458	5,323	6,183	5,200	8,591	6,715	6,329	75,463
Northern [2]	2,268	2,299	2,851	1,376	1,965	2,140	1,420	1,531	1,490	2,323	1,903	2,150	23,716
Wyoming	492	393	432	347	377	380	322	326	387	631	567	523	5,177
Other States [3]	7	6	6	6	5	3	3	3	4	5	6	7	61
Total bituminous	37,079	35,149	38,970	22,134	26,955	30,260	22,511	26,322	25,321	38,120	33,747	35,805	372,373
Pennsylvania anthracite [4]	5,790	4,652	3,228	4,763	5,118	5,724	3,502	3,073	4,113	4,132	3,432	4,632	52,159
Grand total	42,869	39,801	42,198	26,897	32,073	35,984	26,013	29,395	29,434	42,252	37,179	40,437	424,532

[1] Includes operations on the N. & W., C. & O., Virginian, K. & M., B. C. & G., and on the B. & O. in Kanawha, Mason, and Clay Counties.
[2] Rest of State, including the Panhandle district and Grant, Mineral, and Tucker Counties.
[3] Includes Arizona, California, Idaho, Oregon, Georgia, North Carolina, South Dakota.
[4] Includes Sullivan County washery and dredge coal, local sales, colliery fuel, and coal shipped by truck from authorized operations.

NUMBER AND SIZE OF MINES

TABLE 16.—*Number and production of commercial bituminous-coal mines, classified by size of output in each State, in 1935* [1]

[Exclusive of product of wagon mines producing less than 1,000 tons]

State	Class 1A over 500,000 net tons		Class 1B 200,000–500,000 net tons		Class 2 100,000–200,000 net tons		Class 3 50,000–100,000 net tons		Class 4 10,000–50,000 net tons		Class 5 less than 10,000 net tons		Total all classes	
	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines [1]	Quantity	Number of mines [1]	State total
Alabama			11	3,420,048	19	2,649,951	23	1,694,096	15	458,602	96	281,813	164	8,504,510
Arkansas					1	129,987	3	175,719	29	696,724	32	130,849	65	1,133,279
Colorado			4	958,885	15	2,152,678	20	1,473,931	37	822,901	187	502,116	263	5,910,511
Illinois	26	20,371,667	41	14,548,977	15	2,181,802	47	3,525,056	96	2,547,922	497	1,350,045	722	44,525,469
Indiana	4	2,670,647	23	7,198,682	20	3,026,466	21	1,587,481	41	979,166	79	291,772	188	15,754,214
Iowa			3	719,299	2	260,887	14	1,060,044	48	1,015,012	196	594,921	263	3,650,163
Kansas			2	526,000	7	1,070,878	5	375,613	22	408,667	141	305,006	177	2,686,164
Kentucky: Eastern	10	8,031,189	38	11,780,109	49	7,073,291	48	3,441,552	73	2,077,071	95	223,605	313	32,626,817
Western	1	535,402	8	2,347,020	21	2,929,356	20	1,535,589	20	507,761	112	278,994	182	8,134,122
Maryland					4	591,683	7	478,672	17	405,333	86	202,371	114	1,678,059
Michigan					2	247,702	3	218,231	6	140,378	9	22,073	20	628,384
Missouri	1	578,724	3	901,504	3	505,444	7	447,961	38	795,187	149	417,176	201	3,645,996
Montana	1	1,142,319	3	985,372	2	302,526	2	133,132	2	24,434	71	171,123	81	2,758,906
New Mexico			2	545,909	3	393,828	2	134,880	10	243,566	32	70,694	49	1,388,877
North Dakota			3	753,527	3	485,921	2	120,577	12	244,940	141	350,545	161	1,955,510
Ohio	8	5,117,181	22	6,666,336	25	3,602,772	34	2,685,262	81	1,690,445	564	1,391,155	734	21,153,151
Oklahoma					1	180,082	1	65,984	35	800,604	67	182,728	104	1,229,398
Pennsylvania	47	35,979,748	82	25,427,283	100	14,053,116	104	7,262,821	276	6,240,098	756	2,441,604	1,365	91,404,670
South Dakota											17	13,243	17	13,243
Tennessee			4	953,301	15	1,981,223	7	471,439	23	572,187	55	159,652	104	4,137,802
Texas			1	412,399			2	176,790	7	142,588	8	25,752	18	757,529
Utah			6	1,378,528	6	818,017	6	430,249	7	279,383	15	40,741	40	2,946,918
Virginia	1	759,151	15	4,953,845	14	2,095,454	18	1,324,665	17	485,578	17	48,325	82	9,667,018
Washington			1	254,786	5	647,880	3	215,286	16	359,674	31	81,580	56	1,559,206
West Virginia	33	23,916,954	146	44,143,108	140	20,532,560	99	6,894,173	116	3,106,251	212	586,015	746	99,179,061
Wyoming			11	3,567,554	7	993,938	4	249,031	10	278,481	36	88,138	68	5,177,142
Other States [2]							1	73,049	2	65,422	15	28,532	18	167,003
	132	99,102,982	429	132,442,472	479	68,907,442	503	36,251,283	1,056	25,388,375	3,716	10,280,568	6,315	372,373,122

[1] As in 1934, the 1935 figures of total number of mines and of number in class 5 (less than 10,000 tons) are not comparable with years before 1934 in a number of States because of more complete coverage of small trucking mines made possible by cooperation of the Divisional Code Authorities. See Minerals Yearbook, 1936, pp. 561–564.

[2] Includes Alaska, Arizona, California, Georgia, Idaho, North Carolina, and Oregon.

LABOR STATISTICS

MEN EMPLOYED

The method of collecting employment statistics is explained in detail in Coal in 1929, pages 738 to 740. These statistics are believed to represent the most accurate returns obtainable under present conditions, both as to the records generally available in mine offices and as to the funds allotted to the Bureau of Mines for collecting data. (See fig. 51.)

For a detailed explanation of the classification of mine employees see Coal in 1930, page 651. Tables 11 and 44 show the number of men employed underground and on the surface, by States and counties, during 1935.

Bureau of Mines statistics of men employed purport to represent the average number on the rolls of mines active during the year on the days when the mine was in operation.[9]

In computing the average number, the Bureau excludes pay periods when the mine was shut down and giving employment only to maintenance men. Chiefly for this reason, the Bureau of Mines' record of numbers employed shows a higher result than does the average number of wage earners computed at the decennial Censuses of Mines and Quarries of 1909, 1919, and 1929, since the Census average includes the shut-down periods. The differences between the two methods of computation are discussed at length in "Employment and Related Statistics of Mines and Quarries, 1935, part I, Bituminous Coal."[10]

The Bureau's method is believed to give a more accurate measure of the working force of the coal industry. It is also necessary, however, to take account of the time lost by the men on the rolls through intermittent operation. This is best done by recording separately the factor of mine operating time, as indicated by the average number of days worked. In 1935, the bituminous-coal mines operated an average of 179 days. So important is the element of intermittent employment in coal mining that it requires separate measurement, but to measure it in the factor of days worked as well as in the average number of men employed would be to count double.

The two factors of average number of men employed when the mines are in operation and average number of days operated, taken together give the best available measure of employment opportunity in this industry. For 1935, this means that an average of 462,403 men was employed at bituminous-coal mines and that the mines operated 179 days.

DAYS OPERATED

All statistics of days of mine operation issued by the Bureau of Mines represent weighted averages in which the operating time of each mine is weighted by the number of its employees. A number of States that collect statistics of mining, publish figures of days worked that are

[9] A special case arises when mines operate under local share-the-work or staggering agreements and divide the available work among two or more groups of men who work alternately. A few mines, chiefly in Illinois and Indiana, have followed this practice in recent years. Prior to 1935, some of these mines reported to the Bureau the average number of men working and others the total number on the rolls. Beginning with 1935, special arrangements have been made to count only the number working. For the effects of this practice on the employment record in Illinois and Indiana, see footnotes to table 44.

[10] Published as Report E-3, Works Progress Administration National Research Project on Reemployment Opportunities and Recent Changes in Industrial Techniques.

simple averages of all mines reporting, without regard to size. Such an unweighted average is likely to be unduly depressed by the small mines, which generally operate less steadily than the larger, and hence tend to understate the amount of work available to the typical worker. In the interest of uniformity and accuracy it is urged that all such statistics should be weighted, and the method used by the Bureau is recommended as the simplest and most accurate.

MAN-DAYS OF LABOR

Tables 11 and 44 give the best record available of the man-days of labor performed in 1935. A small proportion of bituminous-mine operators keep an accurate record of the man-days or man-hours worked, which is utilized by the Bureau wherever reported. The great majority of the mines, however, indicate that they keep no such record. In that case, the man-days are calculated by the Bureau by multiplying the number employed underground and on the surface by the number of days operated by the mine and tipple, respectively. Although the computations of man-days are made mine by mine, the resulting product is necessarily an approximation and is subject to a considerable margin of error.

Until the American coal industry arranges to keep an accurate record of man-days or man-hours worked, all computations of accident rates, daily earnings, and output per man will remain subject to material qualifications. In the meantime, the computed product of men times days remains the only comprehensive measurement available.

LENGTH OF WORKING DAY

The following tables summarize the replies of mine operators to the question, "Number of hours operated per shift."

The reports of more than 7 hours in 1935 consist partly of (1) cases where the operator has included time when the men are entering or leaving the mine, (2) cases where the operator has reported the time of certain occupations that work longer than other employees, as in stripping overburden, or (3) cases where work is staggered and two crews of men overlap. There were, however, a number of mines in 1935 where the established day was 8 hours. Most of these, as shown by the table, were very small. Numerous mines, especially the smaller ones, failed to answer the question.

Among the mines replying to the inquiry, it was found that 97.8 percent of the men employed were in 7-hour mines and that the weighted average working shift was 7 hours.

The established working day does not of itself measure the length of time that men actually work or the time that they are underground, because of the possibility of overtime, because the mine may sometimes shut down before the full day is over, because the miner may go home before the mine stops, and because he spends a considerable time in going to and from his place of work underground. As interpreted in the wage agreements, the 7-hour day means 7 hours of labor at the usual working place, exclusive of any time for lunch and exclusive of the time spent in going from the entrance of the mine to the working place and back again. (See Coal in 1930, p. 656.)

153336—37——53

TABLE 17.—*Number of bituminous-coal mines in the United States having established working shift of certain length and number of men employed therein, in 1935*

State	7 hours		8 hours		9 hours		Not reporting, and all others [1]		Total	
	Mines	Men	Mines	Men	Mines	Men	Mines	Men	Mines	Men
Alabama	140	17,873	3	40			21	993	164	18,906
Alaska			3	93			1	2	4	95
Arizona, California, Idaho, and Oregon	3	65	1	3			8	35	12	103
Arkansas	56	3,691					9	52	65	3,743
Colorado	158	7,502	36	307			69	344	263	8,153
Georgia and North Carolina	1	91					1	18	2	109
Illinois	401	41,212	66	620	1	10	254	1,906	722	43,748
Indiana	148	10,879	12	113			28	355	188	11,347
Iowa	196	7,465	25	202	1	6	41	365	263	8,038
Kansas	50	2,346	20	194			107	1,356	177	3,896
Kentucky:										
Eastern	211	35,231	25	847	3	372	74	4,178	313	40,628
Western	62	9,397	11	110	1	2	108	2,202	182	11,711
Maryland	81	2,834	7	58	1	2	25	68	114	2,962
Michigan	16	1,195	1	251			3	21	20	1,467
Missouri	48	2,711	50	1,185	3	16	100	1,798	201	5,710
Montana	42	1,334	18	172	2	7	19	58	81	1,571
New Mexico	30	2,246	9	57			10	52	49	2,355
North Dakota	11	173	44	501	6	20	100	671	161	1,365
Ohio	355	26,221	139	1,069	3	14	237	2,220	734	29,524
Oklahoma	72	2,872	7	160	1	12	24	107	104	3,151
Pennsylvania	1,067	120,575	75	677	2	149	221	2,708	1,365	124,109
South Dakota			1	4			16	51	17	55
Tennessee	71	5,484	6	805			27	1,242	104	7,531
Texas	1	9	12	290	3	294	2	199	18	792
Utah	33	2,729	1	7			6	16	40	2,752
Virginia	70	12,653	4	344			8	46	82	13,043
Washington	44	2,034					12	224	56	2,258
West Virginia	640	107,139	23	298			83	1,878	746	109,315
Wyoming	40	3,705	11	198			17	63	68	3,966
Total	4,047	429,666	610	8,605	27	904	1,631	23,228	6,315	462,403

[1] Includes a few small mines where the day was more than 9 or less than 7 hours or was irregular, or where it was changed during the year.

The trend in the length of the working day over the last 32 years is summarized in table 18. As noted, these figures represent the operator's statement of the nominal operating day for the mine. They do not purport to represent the time actually worked by the men. On the one hand, they make no allowance for cases where tonnage or piece workers leave early. On the other hand, they make no allowance for cases where tonnage men continue at work after the mine as a whole is shut down, or go into the mine to work on days when the tipple is idle. Such work beyond the established hours became more frequent in the unorganized areas during the years prior to the N. R. A. code and may have had a material effect in increasing the average hours actually worked, especially in the period 1930 to 1932. This would also affect the calculated output per man per day.

TABLE 18.—*Percentage of men employed in bituminous-coal mines that had established working days of 7, 8, 9, and 10 hours, 1903–35* [1]

Year	Percent of total employees in— 7-hour mines	8-hour mines	9-hour mines	10-hour mines	Weighted average working day (hours)
1903		56.4	17.1	26.5	8.7
1904		62.1	13.8	24.1	8.6
1905		61.1	13.6	25.3	8.6
1906		63.0	13.5	23.5	8.6
1907		64.0	11.6	24.4	8.6
1908		63.5	11.1	25.4	8.6
1910		62.1	11.3	26.6	8.6
1911		62.9	10.9	26.2	8.6
1912		61.6	11.5	26.9	8.6
1913		61.9	15.2	22.9	8.6
1914		60.7	15.4	23.9	8.6
1915		59.6	17.0	23.4	8.6
1916		58.6	17.4	24.0	8.6
1917		79.0	12.6	8.4	8.3
1918		90.6	6.7	2.7	8.12
1919		95.5	3.5	1.0	8.06
1920		97.1	2.0	.9	8.04
1921		96.6	2.9	.5	8.04
1922		95.1	4.0	.9	8.06
1923		94.7	4.2	1.1	8.06
1924		93.7	5.1	1.2	8.08
1925		93.5	5.4	1.1	8.08
1926		93.7	5.5	.8	8.07
1927		93.4	5.6	1.0	8.08
1928		93.1	6.1	.8	8.08
1929		92.5	6.7	.8	8.08
1930		92.4	6.6	1.0	8.09
1931		93.0	6.1	.9	8.08
1932		91.9	6.2	1.9	8.10
1933:					
Before Oct. 2		92.6	4.9	2.5	8.10
After Oct. 2		99.8	.1	.1	8.00
Average for year		94.4	3.7	1.9	8.07
1934:					
Before Apr. 1 [2]		99.8	.1		8.00
After Apr. 1 [3]	97.3	2.6	.1	(4)	7.03
Average for year [5]	73.0	26.9	.1	(4)	7.27
1935	97.8	2.0	.2	(4)	7.02

[1] Calculated on basis of total number of men in mines definitely reported as having 7-, 8-, 9-, or 10-hour day. A small number of mines that work more than 10 hours or less than 7 hours (8 prior to Apr. 1, 1934) have been excluded, as have also all mines for which the reports were defective. Data not available for 1909.

[2] Data as reported for 1933 "after Oct. 2."

[3] Data as reported for December 1934.

[4] Less than 0.05 of 1 percent.

[5] In computing the average for the year the percentages for "before Apr. 1" have been weighted by 3 months and percents "after Apr. 1" by 9 months.

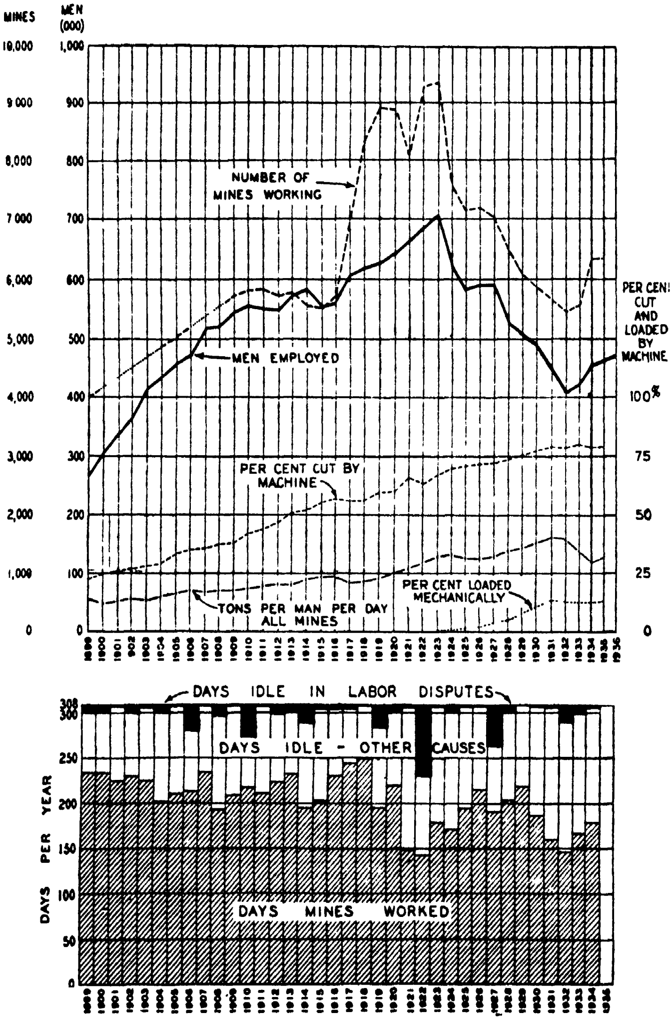


FIGURE 51.—Trends of employment, working time, mechanization, and output per man at bituminous coal mines, 1899–1936.

EQUIPMENT AND METHODS OF MINING AND PREPARATION

METHODS OF RECOVERY

TABLE 19.—*Bituminous coal mined by different methods, by States, in 1935*

State	From underground workings										From strip pits		Grand total production (net tons)
	Mined by hand		Shot off the solid		Cut by machines		Not specified		Total underground				
	Net tons	Percent of total underground	Net tons	Percent of total underground	Net tons	Percent of total underground	Net tons	Percent of total underground	Net tons	Percent of total underground	Net tons	Percent of grand total	
Alabama	773,848	9.1	[1] 1,413,299	16.7	6,276,217	74.1	9,010	0.1	8,472,374	100.0	32,136	0.1	8,504,510
Alaska	11,943	10.0	107,482	90.0					119,425	100.0			119,425
Arizona			5,040	66.8	2,500	33.2			7,540	100.0			7,540
Arkansas	4,720	.4	255,652	23.3	838,518	76.3	200		1,099,090	100.0	34,189		1,133,279
Colorado	1,665,779	28.2	210,813	3.6	4,003,423	67.8	22,195	.4	5,902,210	100.0	8,301	.4	5,910,511
Georgia and North Carolina	3,000	13.2	19,734	86.8					22,734	100.0			22,734
Illinois	1,198,740	3.2	3,690,857	10.0	32,177,962	86.7	47,823	.1	37,115,382	100.0	7,410,087	.1	44,525,469
Indiana	64,829	.7	845,197	9.1	8,318,997	90.2	3,777		9,232,800	100.0	6,521,414		15,754,214
Iowa	443,580	13.0	1,726,445	50.6	1,231,400	36.1	11,646	.3	3,413,071	100.0	237,092	.3	3,650,163
Kansas	145,115	15.3	554,850	58.7	230,011	24.3	15,869	1.7	945,845	100.0	1,740,319	.6	2,686,164
Kentucky:													
Eastern	1,505,420	4.6	[1] 553,052	1.7	30,557,415	93.7	10,930		32,626,817	100.0			32,626,817
Western	84,723	1.0	294,991	3.6	7,741,607	95.2	12,292	.2	8,133,613	100.0	509	.1	8,134,122
Maryland	1,155,755	68.9			510,880	30.4	11,424	.7	1,678,059	100.0		.7	1,678,059
Michigan	4,843	.8	3,140	.5	605,301	98.7	100		613,384	100.0	15,000		628,384
Missouri	317,907	24.6	97,532	7.5	863,684	66.7	15,585	1.2	1,294,708	100.0	2,351,288	.4	3,645,996
Montana	73,455	4.6	36,615	2.3	1,491,887	92.5	10,257	.6	1,612,214	100.0	1,146,692	.4	2,758,906
New Mexico	870,163	62.7	134,210	9.7	381,106	27.4	3,398	.2	1,388,877	100.0		.2	1,388,877
North Dakota	46,672	5.7	216,585	26.4	538,799	65.8	16,971	2.1	819,027	100.0	1,136,483	.9	1,955,510
Ohio	575,263	3.0	103,729	.5	18,371,408	96.2	54,352	.3	19,104,752	100.0	2,048,399	.2	21,153,151
Oklahoma	54,816	5.9	137,135	14.8	730,340	78.5	7,394	.8	929,685	100.0	299,713	.6	1,229,398
Pennsylvania	20,004,334	22.0	2,435,252	2.6	68,473,790	75.3	56,831	.1	90,970,207	100.0	434,463	.1	91,404,670
South Dakota	4,450	66.8			593	8.9	1,622	24.3	6,665	100.0	6,578	12.2	13,243
Tennessee	464,839	11.2	828,437	20.0	2,842,328	68.7	2,198	.1	4,137,802	100.0		.1	4,137,802
Texas	101,792	15.3	564,095	84.7					665,887	100.0	91,642		757,529
Utah	124,206	4.2	[1] 218,637	7.4	2,604,075	88.4			2,946,918	100.0			2,946,918
Virginia	212,331	2.2	[1] 775,792	8.0	8,678,795	89.8	100		9,667,018	100.0			9,667,018
Washington	544,220	34.9	556,466	35.7	458,142	29.4	378		1,559,206	100.0			1,559,206
West Virginia	6,789,377	6.8	[1] 1,373,205	1.4	90,999,085	91.8	16,998		99,178,665	100.0	396		99,179,061
Wyoming	58,220	1.2	249,108	4.9	4,735,945	93.9	1,278		5,044,551	100.0	132,591		5,177,142
Other States	1,792	10.4	14,762	85.3			750	4.3	17,304	100.0		4.3	17,304
Total	37,306,132	10.7	17,422,112	5.0	293,664,208	84.2	333,378	.1	348,725,830	100.0	23,647,292	.1	372,373,122

[1] Includes some tonnage reported by the companies as "pillar coal", the method of mining which, of course, differs materially from solid shooting in rooms or entries.

UNDERCUTTING MACHINES

TABLE 20.—*Number of coal-cutting machines in bituminous-coal mines, average output per machine, and percent of total product of underground mines cut by machines, by States, in 1935*

State	Number of coal-cutting machines in use			Average output per machine (net tons)	Percent of total product of underground mines cut by machines
	"Permissible"	All others	Total		
Alabama	108	230	338	18,569	74.1
Arkansas	65	71	136	6,166	76.3
Colorado	137	246	383	10,453	67.8
Illinois	362	900	1,262	25,498	86.7
Indiana	90	224	314	26,494	90.1
Iowa	54	38	92	13,385	36.1
Kansas	19	15	34	6,765	24.3
Kentucky	506	926	1,432	26,745	94.0
Maryland	19	20	39	13,099	30.4
Michigan	19	38	57	10,619	98.7
Missouri	43	59	102	8,467	66.7
Montana	15	53	68	21,940	92.5
New Mexico	27	16	43	8,863	27.4
North Dakota	18	9	27	19,956	65.8
Ohio	379	602	981	18,727	96.2
Oklahoma	69	45	114	6,406	78.6
Pennsylvania	2,274	1,151	3,425	19,992	75.3
Tennessee	30	92	122	23,298	68.7
Utah	39	83	122	21,345	88.4
Virginia	80	158	238	36,466	89.8
Washington	27	5	32	14,317	29.4
West Virginia	1,065	1,196	2,261	40,247	91.8
Wyoming	58	198	256	18,450	93.9
Other States	2	1	3	1,031	21.8
Total	5,505	6,376	11,881	24,717	84.2

[1] Probably includes some "permissible" machines not so specified by the operators.

STRIPPING OPERATIONS

TABLE 21.—*Stripping operations of all types in the bituminous-coal fields, by States and counties, in 1935*

[Returns for mines that recover coal both by stripping and by underground operations do not permit separating men engaged in stripping from those engaged in other work. For this reason the figures of men employed represent all persons working at these mines, including those underground. The total tons produced by both methods at these same mines are also shown]

State and county	Number of strip pits	Number of power shovels			Coal produced (net tons)		Total value at same mines	Average value per ton	Number of employees				Average number of days mines operated	Percent of county or State total mined by stripping	Man-days of labor	Average tons per man per day
		Steam	Electric	All others	Mined by stripping	Total at same mines			Underground	Surface: In strip pits	Surface: All others	Total				
Alabama:																
Blount and Winston	3	3			5,071	10,233	$22,000	$2.15	5	16	3	24	140	4.6	3,350	3.05
Walker	3	8			27,065	27,065	57,000	2.11		136	11	147	69	1.5	10,203	2.65
Total, Alabama	6	11			32,136	37,298	79,000	2.12	5	152	14	171	79	[1] 1.6	13,553	2.75
Illinois:																
Bureau, Grundy, Hancock, Henry, Jackson, McDonough, Peoria, Schuyler, Shelby, Vermilion, and Will	16	3	22	7	2,369,418	2,369,418	3,846,000	1.62		713	211	924	228	34.7	210,907	11.23
Fulton	10		13	4	1,554,358	1,554,358	2,094,000	1.35		300	150	450	242	71.7	108,946	14.27
LaSalle	13		1	11	110,487	110,487	237,000	2.15		126	23	149	118	26.0	17,525	6.30
Livingston	3				795	795	2,000	2.52		8	2	10	55	4.2	546	1.46
Madison	3			1	11,152	11,152	15,000	1.35		26	5	31	40	.7	1,251	8.91
Perry	6	3	15	4	2,437,163	2,437,163	3,072,000	1.26		633	70	703	247	74.0	173,604	14.04
St. Clair	7			5	125,528	125,528	170,000	1.35		56	11	67	144	5.0	9,636	13.03
Saline	3	1	3	1	262,058	262,058	395,000	1.51		107	15	122	197	8.4	24,090	10.88
Williamson	10	2	2	7	539,128	539,128	843,000	1.56		163	36	199	197	18.3	39,154	13.77
Total, Illinois	71	9	56	40	7,410,087	7,410,087	10,674,000	1.44		2,132	523	2,655	221	16.6	585,659	12.65

Footnotes at end of table.

TABLE 21.—*Stripping operations of all types in the bituminous-coal fields, by States and counties, in 1935*—Continued

State and county	Number of strip pits	Number of power shovels: Steam	Number of power shovels: Electric	Number of power shovels: All others	Coal produced (net tons): Mined by stripping	Coal produced (net tons): Total at same mines	Total value at same mines	Average value per ton	Number of employees: Underground	Number of employees: Surface: In strip pits	Number of employees: Surface: All others	Number of employees: Total	Average number of days mines operated	Percent of county or State total mined by stripping	Man-days of labor	Average tons per man per day
Indiana:																
Clay	17	16	3	21	937,409	937,409	$1,543,000	$1.65		392	112	504	206	88.5	103,597	9.05
Greene	11	5	7	7	1,036,199	1,036,199	1,606,000	1.55		318	81	399	213	64.6	85,005	12.19
Owen	3	2		6	141,680	141,680	265,000	1.87		74	12	86	169	100.0	14,541	9.74
Pike	7	4	11	6	2,465,877	2,465,877	3,011,000	1.22		620	154	774	198	90.4	153,586	16.06
Sullivan	4		4	2	343,783	343,783	583,000	1.70		130	29	159	229	15.2	36,339	9.46
Vermillion	3	2	4		79,707	79,707	112,000	1.41		67	32	99	71	7.3	7,001	11.39
Vigo	4	2	3		761,873	761,873	1,086,000	1.43		195	40	235	215	26.3	50,540	15.07
Warrick	6		2	9	754,886	754,886	883,000	1.17		241	85	326	188	78.2	61,183	12.34
Total, Indiana	55	31	34	51	6,521,414	6,521,414	9,089,000	1.39		2,037	545	2,582	198	41.4	511,792	12.74
Iowa:																
Greene	3		2	2	14,612	14,612	40,000	2.74		17	4	21	118	26.8	2,484	5.88
Hamilton, Keokuk, Van Buren, Wapello, Warren, and Webster	8	1	6	2	80,900	80,900	228,000	2.82		89	12	101	148	25.6	14,988	5.40
Mahaska	7			7	67,631	67,631	131,000	1.94		36	16	52	155	61.8	8,060	8.39
Marion	8	1	1	7	73,949	73,949	172,000	2.33		81	14	95	123	22.3	11,650	6.35
Total, Iowa	26	2	9	18	237,092	237,092	571,000	2.41		223	46	269	138	[1] 29.2	37,182	6.38
Kansas:																
Bourbon	4	1		3	20,515	20,515	34,000	1.66		31	3	34	166	100.0	5,628	3.65
Cherokee	4	1	1		233,489	233,489	446,000	1.91		84	23	107	228	74.7	24,396	9.57
Coffey, Franklin, and Linn	5			3	12,285	12,285	32,000	2.60		56	10	66	86	24.1	5,660	2.17
Crawford	27	16	9	6	1,446,866	1,446,866	2,473,000	1.71		746	112	858	177	68.2	151,662	9.54
Labette	4	2		1	16,471	16,471	33,000	2.00		21	4	25	163	100.0	4,068	4.05
Osage	8			1	10,693	10,693	33,000	3.09		52	9	61	87	12.5	5,300	2.02
Total, Kansas	52	20	10	14	1,740,319	1,740,319	3,051,000	1.75		990	161	1,151	171	64.8	196,714	8.85
Missouri:																
Barton	7	4	5	1	693,492	693,492	1,161,000	1.67		178	68	246	203	99.5	50,038	13.86
Bates	4	2	2	3	692,671	692,671	1,117,000	1.61		240	53	293	211	97.0	61,869	11.20
Boone	3			1	6,188	6,188	11,000	1.78		14	1	15	121	23.8	1,820	3.40
Callaway	3	2		1	26,346	26,346	54,000	2.05		28	4	32	198	69.9	6,329	4.16
Dade, Jasper, Johnson, Randolph, and Warren	5	2	2	3	363,337	363,337	624,000	1.72		103	22	125	274	70.7	34,235	10.61

Henry	5	3	6		489,068	489,068	$887,000	$1.81		223	32	255	189	96.6	48,114	10.16
Vernon	4	4		1	80,186	80,186	133,000	1.66		77	13	90	115	87.2	10,366	7.74
Total, Missouri	31	17	15	10	2,351,288	2,351,288	3,987,000	1.70		863	193	1,056	201	64.5	212,771	11.05
Montana:																
Richland and Valley	3				4,373	9,034	15,000	1.66	10	9	4	23	141	17.2	3,249	2.78
Rosebud	1		2	1	1,142,319	1,142,319	1,466,000	1.28		47	14	61	272	99.9	16,586	68.87
Total, Montana	4		2	1	1,146,692	1,151,353	1,481,000	1.29	10	56	18	84	236	[1]98.1	19,835	58.05
North Dakota:																
Adams, Bowman, Burleigh, Dunn, McKenzie, Mercer, Mountrail, Oliver, Stark, and Ward	15	3	4	4	642,661	642,661	727,000	1.13		173	41	214	204	48.9	43,650	14.72
Burke	7	3	1	4	209,780	209,780	252,000	1.20		96	16	112	246	100.0	27,591	7.60
Divide	3	1	1	3	197,380	197,380	246,000	1.25		50	8	58	215	95.7	12,470	15.83
Grant	3	1		1	15,529	15,529	18,000	1.16		9	6	15	183	64.0	2,750	5.65
Hettinger	9			2	14,089	14,089	17,000	1.21		28	5	33	140	79.4	4,610	3.06
McLean	5	1		4	55,618	56,118	82,000	1.46	2	59	9	70	131	46.6	9,138	6.14
Morton	3				1,426	1,426	2,000	1.40		9		9	58	5.1	518	2.75
Total, North Dakota	45	9	6	18	1,136,483	1,136,983	1,344,000	1.18	2	424	85	511	197	58.1	100,727	11.29
Ohio:																
Columbiana	3	3		3	129,445	129,445	202,000	1.56		41	3	44	171	42.4	7,502	17.25
Coshocton, Hocking, Holmes, Muskingum, Portage, and Vinton	9	3	1	9	272,915	277,348	475,000	1.71	9	143	33	185	226	21.6	41,878	6.62
Harrison	5	16			691,916	691,916	917,000	1.33		314	36	350	204	27.7	71,323	9.70
Jackson	3	4		4	188,684	188,684	335,000	1.78		70	22	92	230	66.1	21,195	8.90
Jefferson	3	7	2		614,976	614,976	796,000	1.29		199	31	230	202	17.1	46,496	13.23
Perry	3	2	1	2	23,925	23,925	31,000	1.30		34	7	41	101	3.3	4,146	5.77
Stark	7	4		13	112,551	122,197	206,000	1.69	14	50	8	72	231	21.5	16,598	7.36
Tuscarawas	7	1		4	13,987	17,819	29,000	1.63	7	20	6	33	117	1.2	3,853	4.62
Total, Ohio	40	40	4	35	2,048,399	2,066,310	2,991,000	1.45	30	871	146	1,047	203	[1]19.8	212,991	9.70
Oklahoma: Haskell, Muskogee, Okmulgee, Rogers, Tulsa, and Wagoner	8	10		1	299,713	299,713	498,000	1.66		199	32	231	168	24.4	38,794	7.73
Pennsylvania: Butler, Clarion, Clearfield, Clinton, Elk, Fayette, McKean, Somerset, Washington, and Westmoreland	13	19		3	434,463	944,383	1,852,000	1.96	469	399	122	990	193	[1].9	190,661	4.95
South Dakota: Corson, Dewey, and Perkins	5			1	6,578	6,578	10,000	1.52		18	11	29	81	49.7	2,350	2.80
Wyoming: Campbell, Carbon, and Converse	4		2	1	132,591	134,305	152,000	1.13	10	28	13	51	222	[1]21.1	11,297	11.89
Other States [2]	8	6	1	1	150,037	151,322	172,000	1.14	33	141	42	216	108	[1]1.9	23,319	6.49
Total United States	368	174	139	194	23,647,292	24,188,445	35,951,000	1.49	559	8,533	1,951	11,043	195	6.4	2,157,645	11.21

[1] Percent of county totals, not State.
[2] Arkansas, Colorado, Kentucky, Michigan, Texas, and West Virginia.

TABLE 22.—*Summary of operations of power strip pits proper in the bituminous-coal fields, by States, in 1935*

State	Number of strip pits	Number of power shovels: Steam	Electric	All others	Amount mined by stripping [1] (net tons)	Average value per ton [2]	Number of men employed [2]	Average number of days mines operated [2]	Average tons per man per day [2]
Power strip pits proper:									
Alabama	5	10			30,752	$2.11	161	72	2.66
Illinois	47	9	56	40	7,384,038	1.44	2,502	230	12.81
Indiana	52	31	34	51	6,517,884	1.39	2,574	199	12.75
Iowa	23	2	9	18	234,891	2.41	257	141	6.49
Kansas	35	20	10	14	1,723,182	1.75	1,048	179	9.19
Missouri	27	17	15	10	2,348,496	1.70	1,041	203	11.11
Montana	1		2	1	1,142,319	1.28	61	272	68.87
North Dakota	19	9	6	18	1,106,587	1.18	411	223	12.10
Ohio	33	37	4	34	2,028,138	1.44	984	205	10.04
Oklahoma	7	10		1	299,563	1.66	229	169	7.73
Pennsylvania	7	11		2	182,645	1.54	117	204	7.66
Other States [3]	6	4	2	2	268,569	1.11	176	169	9.04
Total	262	160	138	191	23,267,064	1.47	9,561	203	12.01
Horse stripping operations	90				98,507	1.82	415	83	2.86
Mines combining stripping and underground methods in same operation [4]	16	14	1	3	281,721	2.04	1,067	175	4.41
Grand total	368	174	139	194	23,647,292	1.49	11,043	195	11.21

[1] Exclusive of coal produced by underground mining in the same operation.
[2] Items in these columns include underground mining conducted in the same operation.
[3] Includes Arkansas, Colorado, Michigan, South Dakota, Texas, and Wyoming.
[4] Includes operations in Alabama, Arkansas, Kentucky, Montana, North Dakota, Ohio, Pennsylvania, and Wyoming, in which the output was obtained by both methods. In addition to the 281,721 tons produced by stripping, this group of 16 mines obtained 541,153 tons by underground methods, its total production by both methods being 822,874 tons.

LOADING MACHINES AND CONVEYORS, WITH SALES IN 1936

Mechanical loading in 1935.—The figures of mechanical loading refer to all mechanical devices designed to reduce the labor of hand shoveling into mine cars. The data for 1935 are based upon complete returns courteously furnished by coal operators to the Bureau of Mines.[11]

[11] The Bureau appreciates the cooperation of the manufacturers of loading equipment and of the Pennsylvania Department of Mines, the Illinois Department of Mines and Minerals, the State coal-mine inspector of Wyoming, and Jonas Waffle of Indiana in furnishing information used in the compilation.

TABLE 23.—*Tonnage of bituminous coal loaded mechanically underground in 1935*

	Net tons	Percent
Loaded by machine:		
Mobile loading machines	24, 675, 248	86.9
Scraper loaders	1, 118, 201	3.9
Conveyors equipped with duckbills and other self-loading devices	2, 594, 564	9.2
Total loaded by machine	28, 388, 013	100.0
Handled by conveyors:		
Conveyors equipped with duckbills and other self-loading devices	2, 594, 564	12.1
Pit-car loaders	11, 098, 466	51.9
Other hand-loaded conveyors	7, 690, 745	36.0
Total handled by conveyors	21, 383, 775	100.0
Recapitulation, less duplications:		
Mobile loading machines	24, 675, 248	52.3
Scraper loaders	1, 118, 201	2.4
Pit-car loaders	11, 098, 466	23.5
Other conveyors, including conveyors equipped with duckbills and other self-loading devices	10, 285, 309	21.8
Grand total loaded mechanically	47, 177, 224	100.0

TABLE 24.—*Comparative change in tonnage loaded by principal types of machines, 1934–35*

	1934 net tons	1935 net tons	Increase (+) or decrease (−), 1935	
			Net tons	Percent
Mobile loading machines	20, 749, 534	24, 675, 248	+3, 925, 714	+18.9
Scraper loaders	1, 004, 480	1, 118, 201	+113, 721	+11.3
Duckbills and other self-loading conveyors	2, 082, 046	2, 594, 564	+512, 518	+24.6
Total loaded by machines	23, 836, 060	28, 388, 013	+4, 551, 953	+19.1
Pit-car loaders	11, 088, 919	11, 098, 466	+9, 547	+.1
Other hand-loaded conveyors	6, 507, 756	7, 690, 745	+1, 182, 989	+18.2
Grand total	41, 432, 735	47, 177, 224	+5, 744, 489	+13.9

TABLE 25.—*Percent of total bituminous deep-mined output mechanically loaded, 1933–35*

[Figures show proportion of the total production from underground mines that was loaded by machine or handled on pit-car loaders and other hand-loaded conveyors]

State	1933	1934	1935	Change (in points) 1935 over 1934
Wyoming	75.8	84.1	89.8	+5.7
Montana	79.5	79.1	80.1	+1.0
Indiana	48.6	61.4	62.5	+1.1
Illinois	53.9	52.6	55.3	+2.7
Utah	20.6	24.9	30.5	+5.6
Washington	19.4	24.6	27.6	+3.0
Arkansas	17.0	25.1	26.6	+1.5
Alabama	16.0	11.8	15.4	+3.6
Ohio	5.5	5.8	7.8	+2.0
Pennsylvania	8.5	7.3	7.1	−.2
Virginia	4.5	4.1	6.7	+2.6
Tennessee	(1)	(1)	5.6	(1)
Colorado	1.4	1.3	3.3	+2.0
West Virginia	.8	1.4	2.1	+.7
Kentucky	2.2	1.9	1.3	−.6
United States	12.0	12.2	13.5	+1.3

1 Concealed to avoid disclosing results of individual operations.

TABLE 26.—*Comparative changes in mechanical loading by principal types of machines, by States, in net tons, 1934–35*

State	1934, net tons			1935, net tons			Increase (+) or decrease (−), 1935						Percent handled by each class			
							Net tons			Percent			1934		1935	
	Loaded by machines [1]	Handled by conveyors [2]	Total	Loaded by machines [1]	Handled by conveyors [2]	Total	Loaded by machines [1]	Handled by conveyors [2]	Total	Loaded by machines	Handled by conveyors	Total	Loaded by machines	Handled by conveyors	Loaded by machines	Handled by conveyors
Alabama	142,505	928,781	1,071,286	286,483	1,017,170	1,303,653	+143,978	+88,389	+232,367	+101.0	+9.5	+21.7	13.3	86.7	[3] 22.0	78.0
Arkansas	(4)	(4)	208,826	(4)	(4)	292,064	(4)	(4)	[5] +83,238	(4)	(4)	[5] +39.9	(4)	(4)	(4)	(4)
Colorado	(4)	(4)	65,076	97,269	100,050	197,319	(4)	(4)	[6] +132,243	(4)	(4)	[6] +203.2	(4)	(4)	[7] 49.3	[8] 50.7
Illinois	11,643,841	6,838,506	18,482,347	12,809,739	7,703,343	20,513,082	+1,165,898	+864,837	+2,030,735	+10.0	+12.6	+11.0	63.0	37.0	[9] 62.4	[10] 37.6
Indiana	4,199,727	1,202,959	5,402,686	4,986,408	781,288	5,767,696	+786,681	−421,671	+365,010	+18.7	−35.1	+6.8	77.7	22.3	[9] 86.5	[10] 13.5
Kentucky	(4)	(4)	743,629	(4)	(4)	533,250	(4)	(4)	[11] −210,379	(4)	(4)	[11] −28.3	(4)	(4)	(4)	(4)
Maryland	----------	(4)	(4)	----------	(4)	(4)	----------	(4)	(4)	--------	(4)	(4)	--------	100.0	--------	100.0
Missouri	----------	(4)	(4)	----------	(4)	(4)	----------	(4)	(4)	--------	(4)	(4)	--------	100.0	--------	100.0
Montana	876,837	271,591	1,148,428	959,596	331,777	1,291,373	+82,759	+60,186	+142,945	+9.4	+22.2	+12.4	76.4	23.6	[7] 74.3	[12] 25.7
New Mexico	(4)	----------	(4)	(4)	----------	(4)	(4)	----------	(4)	(4)	--------	(4)	100.0	--------	100.0	--------
North Dakota	(4)	----------	(4)	(4)	----------	(4)	(4)	----------	(4)	(4)	--------	(4)	100.0	--------	100.0	--------
Ohio	1,136,398	----------	1,136,398	1,488,303	----------	1,488,303	+351,905	----------	+351,905	+31.0	--------	+31.0	100.0	--------	[9] 100.0	--------
Oklahoma	(4)	----------	(4)	(4)	----------	(4)	(4)	----------	(4)	(4)	--------	(4)	100.0	--------	100.0	--------
Pennsylvania	1,385,791	5,162,187	6,547,978	1,387,241	5,082,244	6,469,485	+1,450	−79,943	−78,493	+.1	−1.5	−1.2	21.2	78.8	[7] 21.4	78.6
Tennessee	(4)	(4)	(4)	87,898	145,681	233,579	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	37.6	[8] 62.4
Utah	565,385	34,108	599,493	836,574	61,544	898,118	+271,189	+27,436	+298,625	+48.0	+80.4	+49.8	94.3	5.7	[9] 93.1	6.9
Virginia	----------	384,956	384,956	(4)	(4)	651,807	(4)	(4)	[13] +266,851	(4)	(4)	[13] +69.3	--------	100.0	(4)	(4)
Washington	(4)	(4)	340,685	(4)	(4)	429,617	(4)	(4)	[14] +88,932	(4)	(4)	[14] +26.1	(4)	(4)	(4)	(4)
West Virginia	691,071	673,865	1,364,936	1,197,119	862,203	2,059,322	+506,048	+188,338	+694,386	+73.2	+27.9	+50.9	50.6	49.4	[7] 58.1	[8] 41.9
Wyoming	2,956,704	614,900	3,571,604	3,774,960	755,072	4,530,032	+818,256	+140,172	+958,428	+27.7	+22.8	+26.8	82.8	17.2	83.3	16.7
Undistributed	237,801	1,484,822	364,407	476,423	1,948,839	518,524	(15)	(15)	(15)	(15)	(15)	(15)	(15)	(15)	(15)	(15)
Total	23,836,060	17,596,675	41,432,735	28,388,013	18,789,211	47,177,224	+4,551,953	+1,192,536	+5,744,489	+19.1	+6.8	+13.9	57.5	42.5	60.2	39.8

[1] Includes mobile loaders, scrapers, duckbills, and other self-loading conveyors.
[2] Includes hand-loaded conveyors and pit-car loaders.
[3] Principally by scraper loaders.
[4] Included under "Undistributed" to avoid disclosing individual operations.
[5] The gain in Arkansas resulted from increased use of hand-loaded conveyors.
[6] The gain in Colorado resulted from increased use of mobile loaders and hand-loaded conveyors.
[7] Principally by mobile loaders.
[8] Entirely by conveyors.
[9] Entirely by mobile loaders.
[10] Principally by pit-car loaders.
[11] In Kentucky, increase by hand-loaded conveyors was offset by a decline by pit-car loaders.
[12] Entirely by pit-car loaders.
[13] Most of the increase in Virginia was by hand-loaded conveyors.
[14] The gain in Washington was by face conveyors.
[15] Included in total, tons loaded and percentage by types not given because State groups are not comparable in 1934 and 1935.

TABLE 27.—*Mechanical loading underground in bituminous coal mines, by States, in 1935*

State	Number of mines				Number of machines					Production mechanically loaded (net tons)			Total production of mechanized mines (net tons)			
	Using loading machines only [1]	Using conveyors only [2]	Using both loading machines and conveyors	Total	Mobile loading machines	Scrapers	Conveyors equipped with duckbills and other self-loading devices	Pit-car loaders	Installations of hand-loaded conveyors [3]	Loaded by machines [1]	Handled by conveyors [2]	Total	Mines using loading machines only [1]	Mines using conveyors only [2]	Mines using both loading machines and conveyors	Total
Alabama	5	12	4	21	(4)	20	(4)	(4)	12	286,483	1,017,170	1,303,653	(4)	1,711,935	(4)	3,084,540
Arkansas	2	10		12		(4)			10	(4)	(4)	292,064	(4)	(4)		305,364
Colorado	1	3	2	6	(4)		(4)		5	97,269	100,050	197,319	(4)	253,931	(4)	505,311
Illinois	21	20	14	55	319			1,319	2	12,809,739	7,703,343	20,513,082	9,228,989	7,798,323	7,831,150	24,858,462
Indiana	17	8	5	30	123			99	2	4,986,408	781,288	5,767,696	4,766,445	729,299	829,800	6,325,544
Kentucky	1	12	1	14	(4)	(4)		(4)	10	(4)	(4)	533,250	(4)	2,235,969	(4)	4,359,878
Maryland		2		2					2		(4)	(4)		(4)		(4)
Missouri		2		2					2		(4)	(4)		(4)		(4)
Montana	3		4	7	28		(4)	38		959,596	331,777	1,291,373	803,813		617,217	1,421,030
New Mexico	2			2	(4)	(4)				(4)		(4)	(4)			(4)
North Dakota	2			2	(4)					(4)		(4)	(4)			(4)
Ohio	7			7	27					1,488,303		1,488,303	3,365,941			3,365,941
Oklahoma	1			1		(4)				(4)		(4)	(4)			(4)
Pennsylvania	10	44	5	59	41	19	(4)	(4)	41	1,387,241	5,082,244	6,469,485	(4)	12,809,607	(4)	19,412,856
Tennessee	1	1	2	4	(4)	(4)			3	87,898	145,681	233,579	(4)	(4)	(4)	637,058
Utah	8	2	1	11	37			(4)	2	836,574	61,544	898,118	1,589,202	(4)	(4)	1,773,604
Virginia	1	3		4	(4)				3	(4)	(4)	651,807	(4)	(4)		1,244,749
Washington	1	4		5			(4)		4	(4)	(4)	429,617	(4)	(4)		471,738
West Virginia	19	28	2	49	38	(4)	(4)		31	1,197,119	862,203	2,059,322	(4)	6,284,949	(4)	12,925,367
Wyoming	11	7	6	24	22	(4)	150	70	6	3,774,960	755,072	4,530,032	2,290,751	(4)	(4)	4,714,955
Undistributed					22	39	30	572		476,423	1,948,839	518,524	10,995,851	3,109,909	9,266,949	1,114,133
Total	113	158	46	317	657	78	180	2,098	135	28,388,013	18,789,211	47,177,224	33,040,992	34,933,922	18,545,116	86,520,030

[1] Includes mobile loading machines, scrapers, and conveyors equipped with duckbills and other self-loading heads.
[2] Includes hand-loaded conveyors and pit-car loaders.
[3] Number of mines in which hand-loaded conveyors (other than pit-car loaders) were used.
[4] Included under "Undistributed" to avoid disclosing individual operations.

Sales of mechanical loading equipment in 1936.—The trend of mechanization in 1936 is indicated by the manufacturers' sales of equipment made during the year. Tables 28 and 29 show the number of loading devices in use in 1935 and the number of new machines shipped into various geographical areas in 1936. Further details are given in the chapter on Progress in Mine Mechanization.

TABLE 28.—*Number of mobile loaders and scrapers sold in 1936 compared with the number in actual use in 1935, by regions*

	Mobile loaders		Scrapers	
	In use in 1935	Sales in 1936	In use in 1935	Sales in 1936
Northern Appalachian States:				
Pennsylvania—central	----------	6	19	2
Pennsylvania—western	41	} 82	{ ----------	----------
Ohio	27		----------	----------
Southern Appalachian States:				
West Virginia—northern	6	50	----------	----------
West Virginia—southern, and Virginia	33	60	3	5
Alabama		9	20	5
Kentucky [1]	} 8	5	} 4	{ ----------
Tennessee		----------		1
Middle Western States:				
Illinois	319	95	----------	----------
Indiana	123	22	----------	----------
Trans-Mississippi States: Colorado, Montana, New Mexico, Oklahoma, Utah, and Wyoming	100	15	32	6
Total bituminous	657	344	78	19

[1] Includes sales in east and west Kentucky.

TABLE 29.—*Number of conveyors sold in 1936 compared with the number in actual use in 1935, by regions* [1]

	Conveyors in use in 1935 [2]	Sales of conveyors in 1936 [2]
Northern Appalachian States:		
Pennsylvania—central, and Maryland	} 347	44
Pennsylvania—western		33
Ohio	----------	49
Southern Appalachian States:		
West Virginia—northern	8	32
West Virginia—southern	63	207
Virginia	44	32
Kentucky	[3] 15	[4] 36
Alabama and Tennessee	78	55
Middle Western States: Illinois and Indiana	12	18
Trans-Mississippi States: Arkansas, Colorado, Iowa, Missouri, Montana, Oklahoma, Utah, Washington, and Wyoming	282	154
Total bituminous	849	660

[1] The figures of number in use in 1935 are not exactly comparable with the number sold in 1936 because of uncertainties in defining what constitutes a conveyor. The comparison, however, will serve to indicate which regions have made the largest proportionate increases.
[2] Includes hand-loaded conveyors and conveyors equipped with duckbills or other self-loading heads.
[3] East Kentucky only in 1935.
[4] Includes a small number sold for use in western Kentucky.

MECHANICAL CLEANING

Data on mechanical cleaning of coal are given in tables 30 to 35, inclusive. The figures are based on reports furnished by coal operators. (See fig. 52.) The manufacturers of cleaning equipment have also cooperated. For a review of the growth of mechanical cleaning the reader is referred to Statistical Analysis of the Progress in Mechanical Cleaning of Bituminous Coal from 1927 to 1934, by L. N. Plein, Economic Paper 18, Bureau of Mines, 25 pages.

TABLE 30.—*Bituminous coal mechanically cleaned by wet and pneumatic methods, 1934–35, in net tons of clean coal*

	1934	1935	Increase (+) or decrease (−), 1935	
			Net tons	Percent
By wet methods:				
At the mines	27,555,730	31,006,643	+3,450,913	+12.5
At central washeries operated by consumers	3,972,845	5,849,845	+1,877,000	+47.2
Total wet	31,528,575	36,856,488	+5,327,913	+16.9
By pneumatic methods	8,297,984	8,504,533	+206,549	+2.5
Grand total	39,826,559	45,361,021	+5,534,462	+13.9

TABLE 31.—*Classification by types of equipment used in cleaning bituminous coal, 1934–35*

[Coal cleaned at central washeries operated by consumers in Colorado and Pennsylvania is included]

	Net tons of clean coal		Increase (+) or decrease (−), 1935		Percent cleaned by each type	
	1934	1935	Net tons	Percent	1934	1935
Wet methods:						
Jigs	[1] 14,012,058	15,735,039	+1,722,981	+12.3	[1] 35.2	34.7
Concentrating tables [2]	1,116,154	1,117,789	+1,635	+.1	2.8	2.5
Jigs in combination with concentrating tables [2]	[1] 1,227,413	1,549,422	+322,009	+26.2	[1] 3.1	3.4
Launders and upward-current classifiers	15,167,450	18,454,238	+3,286,788	+21.7	38.1	40.7
Unspecified	5,500		−5,500		0	
Total wet	31,528,575	36,856,488	+5,327,913	+16.9	79.2	81.3
Pneumatic methods	8,297,984	8,504,533	+206,549	+2.5	20.8	18.7
Grand total	39,826,559	45,361,021	+5,534,462	+13.9	100.0	100.0

[1] Information obtained in 1935 indicated that 1 of the plants classed as using jigs only in 1934 was actually using jigs in combination with concentrating tables. The figures for 1934 have been revised accordingly.
[2] A more representative figure for the use of wet tables is indicated by combining the totals for concentrating tables with the total for jigs in combination with concentrating tables. This shows a net gain of 323,644 tons (13.8 percent) for 1935.

TABLE 32.—*Total production of all coal at mines with cleaning plants, 1934–35, in net tons*

[Does not include any estimate for mines that may ship to consumer-operated plants]

	1934	1935	Increase (+) or decrease (−), 1935	
			Net tons	Percent
Wet methods:				
Jigs	[1] 29,820,788	34,892,156	+5,071,368	+17.0
Concentrating tables	1,868,541	1,490,635	−377,906	−20.2
Jigs in combination with concentrating tables	[1] 1,532,938	1,771,351	+238,413	+15.6
Launders and upward-current classifiers	31,440,627	37,768,410	+6,327,783	+20.1
Unspecified	33,853		−33,853	
Total wet	64,696,747	75,922,552	+11,225,805	+17.4
Pneumatic methods	20,080,018	24,030,553	+3,950,535	+19.7
Grand total	84,776,765	99,953,105	+15,176,340	+17.9
Less duplication [2]	8,467,603	12,786,859	+4,319,256	+51.0
Net total	76,309,162	87,166,246	+10,857,084	+14.2
United States production of bituminous coal	359,368,022	372,373,122	+13,005,100	+3.6
Percent produced at mines with cleaning plants	21.2	23.4		

[1] See table 31, footnote 1.
[2] Mines using both wet and pneumatic methods.

TABLE 33.—*Cleaning plants, classified by types, in actual operation, 1934–35*

	1934	1935
Wet types:		
Jigs	[1] 129	138
Concentrating tables	10	9
Jigs in combination with concentrating tables	[1] 13	15
Launders and upward-current classifiers	86	93
Unspecified	1	
Total wet	239	255
Pneumatic types	53	65
Total, all types	292	320
Number of plants using both wet and pneumatic types	24	32

[1] See table 31, footnote 1.

TABLE 34.—*Bituminous coal mechanically cleaned by wet and pneumatic methods, by States, 1934–35*

[Coal cleaned at central washeries operated by consumers in Colorado and Pennsylvania is included]

State	Clean coal in net tons		Increase (+) or decrease (−), 1935		Percent of State output mechanically cleaned	
	1934	1935	Net tons	Percent	1934	1935
Alabama	7,150,888	6,841,269	−309,619	−4.3	78.2	80.4
Colorado	417,295	492,874	+75,579	+18.1	8.0	8.3
Illinois	1,195,588	3,154,128	+1,958,540	+163.8	2.9	7.1
Indiana	1,127,654	1,283,555	+155,901	+13.8	7.6	8.2
Kansas and Missouri	813,488	1,169,351	+355,863	+43.7	13.9	18.5
Kentucky	308,735	351,568	+42,833	+13.9	.8	.9
Michigan and Ohio	1,260,654	1,151,546	−109,108	−8.7	5.9	5.3
Pennsylvania	15,652,268	17,844,642	+2,192,374	+14.0	17.4	19.5
Tennessee	341,530	341,117	−413	−.1	8.3	8.3
Virginia	515,810	389,548	−126,262	−24.5	5.5	4.0
Washington	400,336	614,771	+214,435	+53.6	28.9	39.4
West Virginia	10,486,956	11,613,813	+1,126,857	+10.7	10.7	11.7
Other States [1]	155,357	112,839	−42,518			
Total	39,826,559	45,361,021	+5,534,462	+13.9	11.1	12.2

[1] For 1934 includes Arkansas, Maryland, Montana, New Mexico, and Oklahoma. For 1935 includes Arkansas, Maryland, Montana, and New Mexico.

TABLE 35.—*Method of mining at mines served by cleaning plants*

	1934	1935	Increase, 1935	
	Net tons		Net tons	Percent
Mined from strip pits	7,127,710	9,314,425	2,186,715	30.7
Mechanically loaded underground	10,128,745	15,065,777	4,937,032	48.7
Hand loaded underground	59,052,707	62,786,044	3,733,337	6.3
Total	76,309,162	87,166,246	10,857,084	14.2

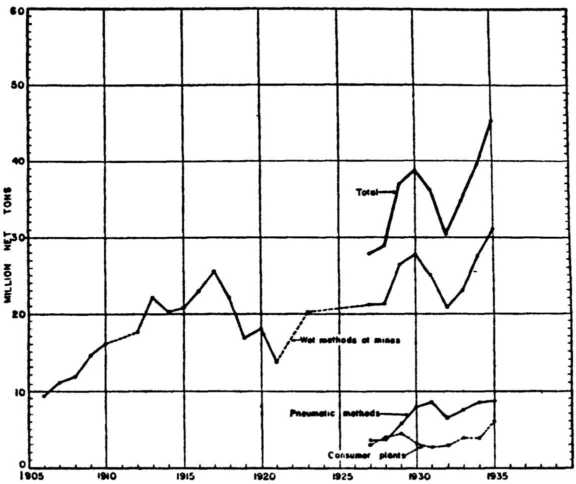


FIGURE 52.—Tonnage of bituminous coal mechanically cleaned, 1906–35.

FUEL ECONOMY

TABLE 36.—*Indicators of the effect of fuel economy on consumption of coal per unit of performance since the World War*

	Pounds	Reduction (percent)
Steam railroads:		
Pounds per 1,000 gross ton-miles freight service:		
Average, 1919–20	170	
Average, 1935	120	29.4
Pounds per passenger-train car-mile:		
Average, 1919–20	18.5	
Average, 1935	15.5	16.2
Electric-public-utility power plants:		
Pounds per kilowatt-hour, 1919	3.2	
Pounds per kilowatt-hour, 1935	1.5	53.1
Iron and steel—pounds coking coal per ton of pig: [1]		
1918	3,577	
1935	2,838	20.7
Coke manufacture: Savings of heat values through recovery of gas, tar, light oils, and breeze by extension of byproduct in place of beehive coking, 1913–35, expressed as percent of coal used for all coke in 1935 [2]		20.0

[1] Includes only savings through higher yields of merchantable coke per ton of coal charged and lower consumption of coke per ton of iron. Excludes economies through recovery of byproducts, which are treated in next item.

[2] These byproducts are used in part for boiler fuel, in part for metallurgical purposes, in part for domestic heating and cooking, and to a small extent for automotive fuel.

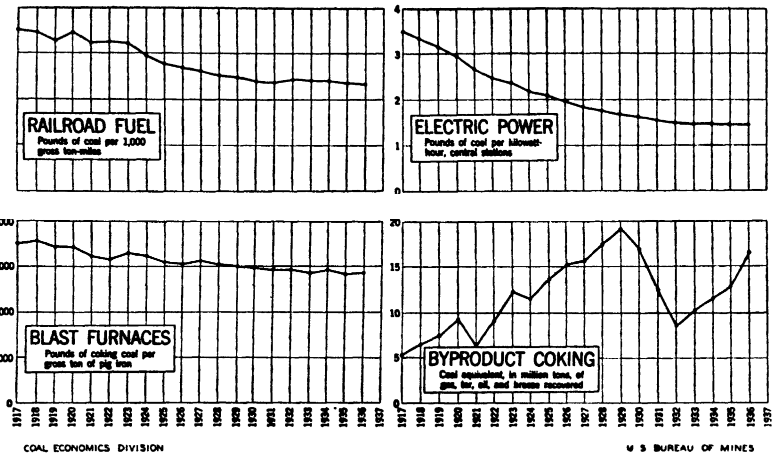


FIGURE 53.—Trends in fuel efficiency in the United States, 1917-36.

STOCKS OF COAL HELD BY CONSUMERS

TABLE 37.—*Stocks of bituminous coal in hands of commercial consumers and of anthracite and bituminous coal in retail dealers' yards in 1936*

Date	Total stock of bituminous coal, estimated (net tons)	Day's supply at current rate of consumption on date of stock taking								
		Byproduct coke plants	Steel plants	Other industrials	Coal-gas plants	Electric utilities	Retail yards, bituminous	Railroads	Total bituminous	Retail yards, anthracite
Jan. 1	34,476,000	49	27	30	70	63	27	22	32	36
Feb. 1	32,045,000	38	21	24	63	60	19	21	26	24
Mar. 1	32,197,000	35	23	23	59	61	19	24	26	23
Apr. 1	38,543,000	42	42	34	73	75	26	39	37	24
May 1	36,249,000	44	41	35	77	77	31	32	38	27
June 1	35,541,000	43	46	38	72	80	47	35	43	36
July 1	41,127,000	51	56	47	88	81	64	45	52	44
Aug. 1	40,772,000	55	51	47	96	78	78	47	55	54
Sept. 1	40,378,000	54	44	45	93	71	65	41	51	72
Oct. 1	40,904,000	50	43	47	90	70	44	32	45	60
Nov. 1	39,553,000	42	33	38	86	61	43	27	39	62
Dec. 1	39,911,000	41	30	37	80	63	41	26	38	64
Dec. 31	37,017,000	36	26	32	75	60	23	23	30	35

BITUMINOUS COAL LOADED FOR SHIPMENT BY INDIVIDUAL RAILROADS AND WATERWAYS

The table shows the quantity so originated on each railroad and waterway, as reported by mine operators in answer to the following inquiry:

Railroads or waterways on which product was first loaded for shipment:
Name of road or waterway --

(Give shipments over each road separately) *Tons*

As these statistics include nonrevenue railroad fuel they may differ from statistics compiled by the railroad companies, which often show only revenue freight and include coal received from connecting lines

or coal shipped off the Lake docks, as well as that originating at mines on the lines reporting.

Where the road serving the district is a subsidiary of a larger road some operators may report their coal as loaded on the subsidiary and others as loaded on the parent system (a few subsidiaries have been consolidated under the name of the parent road).

In general, the figures are given under the name reported by the operator; and the Bureau of Mines does not attempt to combine them under the name of the larger system, believing that such combination can best be made by those using the figures, as they are probably familiar with coal-traffic problems. If such combination is made, the total will usually be found to check reasonably well with the statistics issued by railroads that keep records of total coal originated.

TABLE 38.—*Bituminous coal loaded for shipment in 1935 by individual railroads and waterways, as reported by operators, in net tons*

Route	State	Quantity	
		By State	Total for route
RAILROADS			
Alabama Central	Alabama	19,439	19,439
Alabama Great Southern	do	125,758	125,758
Alaska	Alaska	112,260	112,260
Algers, Winslow & Western	Indiana	1,494,652	1,494,652
Alton	Illinois	738,054	798,086
	Missouri	60,032	
Artemus-Jellico	Kentucky	357,727	357,727
Atchison, Topeka & Santa Fe	Colorado	131,072	2,589,405
	Illinois	717,649	
	Kansas	560,221	
	Missouri	190,324	
	New Mexico	990,139	
Baltimore & Ohio	Illinois	483,358	23,722,721
	Indiana	454,814	
	Maryland	42,474	
	Ohio	3,275,552	
	Pennsylvania	9,483,378	
	West Virginia	9,983,145	
Bessemer & Lake Erie	Pennsylvania	2,942,892	2,942,892
Buffalo Creek & Gauley	West Virginia	614,295	614,295
Cambria & Indiana	Pennsylvania	2,881,876	2,881,876
Campbell's Creek	West Virginia	934,465	934,465
Carbon County	Utah	224,722	224,722
Caseyville	Illinois	141,819	141,819
Central of Georgia	Alabama	719,621	738,940
	Georgia	19,319	
Chesapeake & Ohio	Kentucky	7,497,874	42,494,833
	Ohio	950,261	
	West Virginia	34,046,698	
Cheswick & Harmar	Pennsylvania	600,919	600,919
Chicago & Eastern Illinois	Illinois	1,510,697	4,166,116
	Indiana	2,655,419	
Chicago & Illinois Midland	Illinois	3,413,722	3,413,722
Chicago & North Western	do	2,328,766	2,430,639
	Iowa	78,014	
	Wyoming	23,859	
Chicago, Burlington & Quincy	Colorado	272,353	7,325,040
	Illinois	5,997,001	
	Iowa	231,981	
	Missouri	80,335	
	Wyoming	743,370	
Chicago Great Western	Iowa	36,744	36,744
Chicago, Indianapolis & Louisville	Indiana	1,081,714	1,081,714
Chicago, Milwaukee, St. Paul & Pacific	do	3,847,500	5,256,660
	Iowa	582,720	
	Missouri	37,194	
	Montana	772,781	
	North Dakota	8,478	
	South Dakota	1,862	
	Washington	6,125	
Chicago, Rock Island & Pacific	Illinois	537,641	1,442,141
	Iowa	621,301	
	Missouri	148,636	
	Oklahoma	134,563	

TABLE 38.—*Bituminous coal loaded for shipment in 1935 by individual railroads and waterways, as reported by operators, in net tons*—Continued

Route	State	Quantity: By State	Quantity: Total for route
RAILROADS—continued			
Chicago, Springfield & St. Louis	Illinois	340,372	340,372
Cleveland, Cincinnati, Chicago & St. Louis	do	3,167,092	4,432,374
	Indiana	1,265,282	
Clinchfield	Kentucky	73,195	1,713,888
	Virginia	1,640,693	
Colorado & Southeastern	Colorado	175,961	175,961
Colorado & Southern	do	712,910	712,910
Colorado & Wyoming	do	291,532	291,532
Conemaugh & Black Lick	Pennsylvania	31,223	31,223
Crystal River & San Juan	Colorado	1,167	1,167
Cumberland & Pennsylvania	Maryland	777,770	777,770
Dardanelle & Russellville	Arkansas	47,687	47,687
Dents Run	Pennsylvania	6,743	6,743
Denver & Intermountain	Colorado	109,948	109,948
Denver & Rio Grande Western	do	1,059,060	2,607,917
	New Mexico	23,017	
	Utah	1,525,840	
Denver & Salt Lake	Colorado	733,866	733,866
Des Moines & Central Iowa	Iowa	142,612	142,612
Detroit, Toledo & Ironton	Ohio	7,246	7,246
East Broad Top Railroad & Coal Co	Pennsylvania	502,045	502,045
Eastern Railway & Lumber Co	Washington	10,473	10,473
Erie	Ohio	250	1,217,221
	Pennsylvania	1,216,971	
Evansville & Ohio Valley	Indiana	15,148	15,148
Evansville, Suburban & Newburgh	do	157,841	157,841
Fort Dodge, Des Moines & Southern	Iowa	8,927	8,927
Fort Smith & Western	Oklahoma	88,315	88,315
Fort Smith, Subiaco & Rock Island	Arkansas	7,902	7,902
Great Northern	Montana	369,912	799,238
	North Dakota	347,169	
	Washington	82,157	
Huntingdon & Broad Top Mountain Railroad & Coal Co.	Pennsylvania	228,184	228,184
Illinois Central	Alabama	189,027	13,253,366
	Illinois	8,020,345	
	Indiana	144,811	
	Kentucky	4,899,183	
Illinois Terminal	Illinois	665,281	665,281
Indiana	Indiana	20,894	20,894
International-Great Northern	Texas	26,344	26,344
Interstate	Kentucky	20,848	1,618,725
	Virginia	1,597,877	
Iowa Southern Utilities Co	Iowa	233,199	233,199
Johnstown & Stony Creek	Pennsylvania	120,794	120,794
Joplin-Pittsburg	Kansas	208,791	208,791
Kanawha Central	West Virginia	177,704	177,704
Kanawha, Glen Jean & Eastern	do	420,975	420,975
Kansas City Southern	Kansas	30,156	647,356
	Missouri	578,724	
	Oklahoma	38,476	
Kansas, Oklahoma & Gulf	do	9,709	9,709
Kelley's Creek & Northwestern	West Virginia	302,761	302,761
Kentucky & Tennessee	Kentucky	382,949	382,949
Lake Erie, Franklin & Clarion	Pennsylvania	104,678	104,678
Laramie, North Park & Western	Colorado	20,094	20,094
Ligonier Valley	Pennsylvania	227,664	227,664
Litchfield & Madison	Illinois	533,416	533,416
Louisville & Nashville	Alabama	1,590,259	24,020,554
	Illinois	45,478	
	Kentucky	21,539,591	
	Tennessee	658,711	
	Virginia	186,515	
Mary Lee	Alabama	580,828	580,828
Michigan Central	Michigan	43,384	43,384
Midland Valley	Arkansas	186,082	418,405
	Oklahoma	232,323	
Minneapolis & St. Louis	Illinois	845,831	872,596
	Iowa	26,765	
Minneapolis, St. Paul & Sault Ste. Marie	North Dakota	459,964	459,964
Missouri-Illinois	Illinois	32,985	32,985
Missouri-Kansas-Texas	Kansas	233,200	583,818
	Missouri	55,094	
	Oklahoma	249,978	
	Texas	45,546	

TABLE 38.—*Bituminous coal loaded for shipment in 1935 by individual railroads and waterways, as reported by operators, in net tons*—Continued

Route	State	Quantity: By State	Quantity: Total for route
RAILROADS—continued			
Missouri Pacific	Arkansas	721,465	6,143,147
	Illinois	3,645,833	
	Kansas	987,344	
	Missouri	788,505	
Mobile & Ohio	Alabama	57,399	290,248
	Illinois	232,849	
Monongahela	Pennsylvania	3,127,745	9,839,905
	West Virginia	6,712,160	
Montana	Arkansas	21,545	21,545
Montana, Wyoming & Southern	Montana	301,409	301,409
Montour	Pennsylvania	4,887,817	4,887,817
Nashville, Chattanooga & St. Louis	Tennessee	813,388	813,388
New Haven & Dunbar	Pennsylvania	4,280	4,280
New York Central (includes coal shipped over Kanawha & Michigan, Kelley's Creek, Toledo & Ohio Central, and Zanesville & Western).	Ohio	5,637,389	10,309,407
	Pennsylvania	3,480,711	
	West Virginia	1,191,307	
Nicholas, Fayette & Greenbrier	do	1,550,874	1,550,874
Norfolk & Western	Kentucky	3,490,164	32,376,147
	Virginia	4,299,448	
	West Virginia	24,586,535	
Norfolk Southern	North Carolina	400	400
Northeast Oklahoma	Kansas	6,313	6,313
Northern Alabama	Alabama	244,255	244,255
Northern Pacific	Montana	1,141,716	2,587,923
	North Dakota	620,323	
	Washington	825,884	
Oklahoma City-Ada-Atoka	Oklahoma	22,990	22,990
Oneida & Western	Tennessee	59,000	59,000
Oregon Short Line	Wyoming	357,821	357,821
Pacific Coast	Washington	211,599	211,599
Pennsylvania (includes Pittsburgh, Cincinnati, Chicago & St. Louis).	Illinois	334,509	35,627,644
	Indiana	1,757,244	
	Ohio	4,082,350	
	Pennsylvania	28,594,605	
	West Virginia	858,936	
Peoria & Pekin Union	Illinois	58,851	58,851
Peoria Terminal	do	972,331	972,331
Pere Marquette	Michigan	220,244	220,244
Pittsburg & Shawmut	Pennsylvania	838,035	838,035
Pittsburg County	Oklahoma	19,890	19,890
Pittsburgh & Lake Erie	Pennsylvania	4,040,490	4,040,490
Pittsburgh & West Virginia	Ohio	370,412	2,134,255
	Pennsylvania	1,734,004	
	West Virginia	29,839	
Pittsburgh, Chartiers & Youghiogheny	Pennsylvania	765	765
Pittsburgh, Lisbon & Western	Ohio	15,821	15,992
	Pennsylvania	171	
Pittsburg, Shawmut & Northern	do	340,783	340,783
Preston	West Virginia	191,958	191,958
Quincy, Omaha & Kansas City	Missouri	92,841	92,841
Rio Grande & Eagle Pass	Texas	18,859	18,859
Rio Grande Southern	Colorado	7,962	7,962
Rockdale, Sandow & Southern	Texas	90,192	90,192
Rutland, Toluca & Northern	Illinois	52,324	52,324
St. Louis & Belleville Electric	do	1,739	1,739
St. Louis & Hannibal	Missouri	3,529	3,529
St. Louis & O'Fallon	Illinois	325,070	325,070
St. Louis-San Francisco	Alabama	821,777	2,096,290
	Arkansas	126,106	
	Kansas	330,556	
	Missouri	465,621	
	Oklahoma	352,230	
St. Louis Southwestern of Texas	Texas	502,333	502,333
San Antonio Southern	do	4,067	4,067
Seaboard Air Line	Alabama	92,166	92,166
Southern	do	1,356,845	6,537,086
	Illinois	179,374	
	Indiana	1,203,146	
	Kentucky	853,763	
	Tennessee	1,514,183	
	Virginia	1,429,775	
Southern Pacific	California	4,400	255,022
	New Mexico	250,622	
Springfield Terminal	Illinois	337,037	337,037
Susquehanna & New York	Pennsylvania	15,683	15,683

TABLE 38.—*Bituminous coal loaded for shipment in 1935 by individual railroads and waterways, as reported by operators, in net tons*—Continued

Route	State	Quantity	
		By State	Total for route
RAILROADS—continued			
Tennessee	Tennessee	559, 297	559, 297
Tennessee Central	do	281, 554	281, 554
Tennessee Coal, Iron & Railroad Co	Alabama	1, 186, 019	1, 186, 019
Texas & Pacific	Texas	5, 000	5, 000
Texas Short Line	do	23, 873	23, 873
Thomas & Sayreton	Alabama	424, 732	424, 732
Toledo, Peoria & Western	Illinois	72, 836	72, 836
Twin City Electric	Washington	889	889
Uintah	Colorado	6, 106	6, 106
Union	Pennsylvania	38, 214	38, 214
Union Pacific	Colorado	857 450	4, 585, 08[illegible]
	Idaho	3, 072	
	Kansas	12, 000	
	Washington	30, 176	
	Wyoming	3, 682, 384	
Unity	Pennsylvania	679, 609	679, 609
Utah	Utah	1, 057, 759	1, 057, 759
Virginian	Virginia	105, 771	8, 666, 963
	West Virginia	8, 561, 192	
Wabash	Illinois	1, 421, 815	1, 913, 967
	Iowa	96, 886	
	Missouri	395, 266	
Western Allegheny	Pennsylvania	118, 993	118, 993
Western Maryland	Maryland	583, 852	4, 096, 236
	Pennsylvania	501, 547	
	West Virginia	3, 010, 837	
West Virginia Northern	do	202, 808	202, 808
Wheeling & Lake Erie	Ohio	3, 019, 362	3, 019, 362
Winfield	Pennsylvania	16, 521	16, 521
Winifrede	West Virginia	61, 556	61, 556
Woodward Iron Co	Alabama	614, 193	614, 193
Youngstown & Suburban	Ohio	84, 572	84, 572
Total railroad shipments		319, 741, 376	319, 741, 376
WATERWAYS			
Allegheny River	Pennsylvania	1, 016, 416	1, 016, 416
Big Sandy River	Kentucky	350	350
Black Warrior River	Alabama	67, 419	67, 419
Green River	Kentucky	106, 856	106, 856
Kanawha River	West Virginia	1, 307, 808	1, 307, 808
Monongahela River	Pennsylvania	14, 168, 608	14, 286, 166
	West Virginia	117, 558	
Muskingum River	Ohio	415, 512	415, 512
Ohio River	Kentucky	170, 854	1, 126, 755
	Ohio	9, 093	
	Pennsylvania	1, 000	
	West Virginia	945, 808	
Total waterway shipments		18, 327, 282	18, 327, 282
Grand total, loaded at mines for shipment by railroads and waterways.		338, 068, 658	338, 068, 658
Commercial sales by truck or wagon		21, 960, 252	21, 960, 252
Other sales to local trade, or used by employees, or taken by locomotives at tipple.		7, 773, 619	7, 773, 619
Used for power and heat or made into coke at mines		4, 570, 593	4, 570, 593
Total production		372, 373, 122	372, 373, 122

IMPORTS AND EXPORTS

IMPORTS

TABLE 39.—*Bituminous coal imported, by countries and districts, 1935–36, in net tons*

Country and district	1935	1936	Country and district	1935	1936
COUNTRY			DISTRICT OF ENTRY—contd.		
North America:			Duluth-Superior	212	----------
Canada	170,330	194,596	Maine and New Hampshire	68,816	76,253
Mexico	----------	35	Massachusetts	24,039	----------
Europe:			Michigan	1	259
Netherlands	----------	67	Montana-Idaho	61,973	72,544
United Kingdom	31,541	54,778	New Orleans	----------	168
Asia: Japan	----------	504	New York	107	67
Oceania: Australia	----------	24	Philadelphia	----------	168
			St. Lawrence	----------	60
Total	201,871	250,004	San Antonio	----------	34
			San Francisco	----------	529
DISTRICT OF ENTRY			Vermont	295	2,100
			Virgin Islands	7,503	54,442
Alaska	15,707	11,806	Washington	19,364	31,346
Buffalo	----------	174			
Dakota	3,854	54	Total	201,871	250,004

EXPORTS

TABLE 40.—*Exports of bituminous coal to (1) Canada and Mexico, (2) the West Indies and Central America, and (3) "overseas" destinations, 1929–36, in thousands of net tons*

Year	(1) Canada and Mexico	(2) West Indies and Central America [1]	(3) "Overseas" (all other countries)							Grand total
			Newfoundland, Miquelon, and Bermuda	South America	Europe	Asia	Africa	Oceania	Total "overseas"	
1929	14,727	1,500	211	332	567	8	84	--------	1,202	17,429
1930	13,667	1,180	95	353	469	14	97	2	1,030	15,877
1931	10,647	755	98	306	246	18	56	--------	724	12,126
1932	8,429	235	6	108	3	8	25	(2)	150	8,814
1933	8,600	223	21	174	7	6	6	--------	214	9,037
1934	10,213	410	40	203	--------	3	--------	--------	246	10,869
1935	9,044	456	31	197	9	5	--------	--------	242	9,742
1936	9,912	470	44	163	50	(3)	(4)	15	272	10,654

[1] Includes Bahamas and Panama. Virgin Islands included prior to 1935.
[2] 2 tons.
[3] 1 ton.
[4] 3 tons.

TABLE 41.—*Bituminous coal exported, by countries, 1935–36, in net tons* [1]

Country	1935	1936
North America:		
Bermuda	6,657	7,062
British Honduras	222	402
Canada	9,038,902	9,906,101
Central America:		
Costa Rica	2	47
Guatemala	274	269
Honduras	484	337
Nicaragua	93	103
Panama	68,905	32,135
Salvador	18	41
Greenland		343
Mexico	4,925	5,886
Miquelon and St. Pierre Islands	16,353	11,720
Newfoundland and Labrador	8,015	24,983
West Indies:		
British:		
Jamaica	23,647	13,154
Trinidad and Tobago	30,780	31,400
Other British	13	3,938
Cuba	324,233	366,853
Dominican Republic	105	74
French	6,479	20,664
Haiti	30	56
Netherland	827	766
	9,530,964	10,426,334
South America:		
Argentina	19,535	28,660
Bolivia		101
Brazil	143,997	110,296
Chile		10,222
South America—continued.		
Colombia	1,019	47
Ecuador	29	26
Guiana:		
British	269	516
Surinam (Netherland)	3,944	2,820
Peru	28,760	3,919
Uruguay		6,620
Venezuela	18	25
	197,571	163,252
Europe:		
Italy	8,771	42,605
United Kingdom	56	7,249
	8,827	49,854
Asia:		
Philippine Islands	5,065	
Saudi Arabia	1	1
Other Asia	2	
	5,068	1
Africa: Liberia		3
Oceania:		
Australia		15,400
French		115
		15,515
Grand total	9,742,430	10,654,959

[1] Amounts stated do not include fuel or bunker coal loaded on vessels engaged in the foreign trade, which aggregated 1,320,623 tons in 1934, 1,576,192 tons in 1935, and 1,447,983 tons in 1936.

TABLE 42.—*Bituminous coal exported, by districts and ports, 1935–36, in net tons*

Customs district	1935	1936
North Atlantic:		
New York	3,476	9,178
Philadelphia	9,138	5,736
Maryland	47,579	105,442
Virginia	567,972	567,054
South Atlantic:		
South Carolina	86,275	64,542
Florida	323	9
Mobile	1,695	9,716
New Orleans	1,683	1,586
Mexican border:		
Arizona	270	207
El Paso	3,989	5,034
San Antonio	165	168
Pacific coast:		
Washington [1]	6,276	6,595
Los Angeles	11	
San Francisco	129	169
San Diego	71	46
Lake Erie ports: Ohio [2]	5,693,577	6,427,522
Rail gateways on Canadian border:		
Eastern:		
Maine and New Hampshire	155	223
Vermont	91	108
Massachusetts	3	2
St. Lawrence	329,189	359,473
Rochester [3]	730,742	741,126
Buffalo	1,135,642	1,103,091
Michigan	1,090,000	1,199,176
Western:		
Duluth-Superior and International Falls	24,222	40,800
Dakota	7,961	7,790
Montana-Idaho	451	
Miscellaneous:		
Alaska	1,327	159
Puerto Rico	17	6
Virgin Islands	1	1
Total	9,742,430	10,654,959

[1] Both rail to Canada and by tide to foreign ports.
[2] Lower lake docks as follows: Toledo, Sandusky, Huron, Lorain, Cleveland, Fairport, Ashtabula, Conneaut, and Erie.
[3] Rail, car ferry, and Lake Ontario.

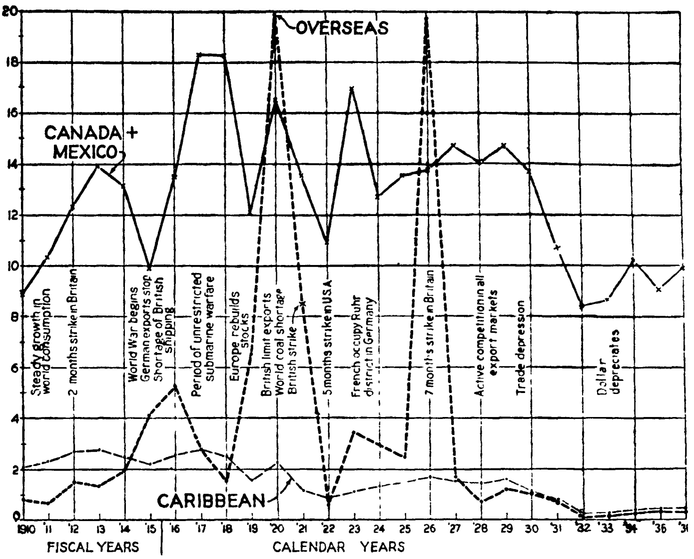


FIGURE 54.—Twenty-seven years' exports of bituminous coal to Canada and Mexico, the Caribbean, and "overseas" destinations.

SHIPMENTS TO ALASKA, HAWAII, AND PUERTO RICO

In addition to the export trade proper, the United States supplies a small tonnage of anthracite and bituminous coal to the Territories of Alaska, Hawaii, and Puerto Rico. In 1935, 26,554 tons were shipped to Alaska, 1,695 tons to Hawaii, and 21,760 tons to Puerto Rico.

WORLD PRODUCTION OF COAL

TABLE 43.—*Coal and lignite produced in the principal countries of the world in the calendar years 1932–36, in thousands of metric tons*

[Compiled by R. B. Miller]

Country	1932	1933	1934	1935	1936
North America:					
Canada:					
Coal	7,507	8,533	9,613	9,358	10,297
Lignite	3,142	3,370	2,916	3,241	3,505
Greenland	5	5	6	6	(1)
Mexico	687	647	782	1,143	1,297
United States:					
Anthracite	45,228	44,943	51,862	46,269	54,760
Bituminous and lignite	280,963	302,663	326,011	335,043	434,070
South America:					
Argentina	(1)	(1)	(1)	(1)	(1)
Brazil	[2] 450	570	622	757	540
Chile	1,080	1,538	1,808	1,695	1,745
Colombia	(1)	(1)	(1)	(1)	(1)
Peru	26	30	35	31	90
Venezuela	5	5	6	1	(1)
Europe:					
Albania: Lignite	3	3	2	2	(1)
Austria:					
Coal	221	239	251	260	244
Lignite	3,104	3,014	2,851	2,971	2,897
Belgium	21,424	25,300	26,389	26,483	27,876
Bulgaria:					
Coal	98	80	79	93	102
Lignite	1,663	1,493	1,568	1,566	1,524

[1] Estimate included in total.
[2] Approximate production.

TABLE 43.—*Coal and lignite produced in the principal countries of the world in the calendar years 1932–36, in thousands of metric tons*—Continued

Country	1932	1933	1934	1935	1936
Europe—Continued.					
Czechoslovakia:					
Coal	11,032	10,627	10,789	10,894	12,353
Lignite	15,787	14,968	15,071	15,114	16,070
France:					
Coal	46,267	46,887	47,607	46,207	45,226
Lignite	1,012	1,093	1,031	902	920
Germany: [3]					
Coal	104,741	109,692	124,910	134,124	146,696
Lignite	122,647	126,794	135,995	147,381	161,337
Saar [4]	10,438	10,561	11,318	10,619	11,684
Greece: Lignite	138	99	104	83	(1)
Hungary:					
Coal	895	800	756	823	827
Lignite	5,931	5,907	6,199	6,839	7,105
Irish Free State	82	107	113	115	(1)
Italy:					
Coal	255	334	295	443	(1)
Lignite	376	383	409	545	(1)
Netherlands:					
Coal	12,756	12,574	12,341	11,878	12,803
Lignite	124	97	92	86	(1)
Poland:					
Coal	28,835	27,356	29,233	28,543	29,748
Lignite	33	33	26	18	14
Portugal:					
Coal	241	209	203	211	230
Lignite	17	11	15	20	(1)
Rumania:					
Coal	188	195	288	278	(1)
Lignite	1,464	1,314	1,624	1,650	(1)
Spain:					
Coal	6,854	5,999	5,932	7,016	(1)
Lignite	336	301	299	304	(1)
Svalbard (Spitsbergen)	266	370	533	659	(1)
Sweden	333	349	415	424	(1)
Switzerland [2]	4	4	3	4	3
U. S. S. R. (Russia):					
Coal	46,967	53,519	64,743	83,800	93,987
Lignite	4,158	16,771	21,809		
United Kingdom:					
Great Britain	212,083	210,436	224,269	226,519	224,619
Northern Ireland	-----	-----	1	4	(1)
Yugoslavia:					
Coal	368	379	387	400	441
Lignite	4,107	3,777	3,926	4,028	4,035
Asia:					
British Borneo	(1)	(1)	(1)	1	1
China	26,376	28,379	32,725	(1)	(1)
Chosen	1,104	1,307	1,689	1,999	(1)
Federated Malay States	282	222	327	383	511
India, British	20,477	20,107	22,411	23,386	20,829
Indochina:					
Coal	1,691	1,591	1,592	1,774	(1)
Lignite	23	-----	-----	-----	(1)
Iran	(1)	[2] 9	9	9	(1)
Iraq [5]	(1)	(1)	(1)	(1)	(1)
Japan:					
Japan proper:					
Coal	27,774	32,133	35,925	37,762	38,067
Lignite	109	116	125	109	(1)
Karafuto	688	889	1,197	1,516	(1)
Taiwan	1,355	1,533	1,521	1,597	(1)
Netherland India	1,050	1,035	1,032	1,111	1,119
Philippine Islands	18	16	(1)	(1)	(1)
Syria: Lignite	(1)	(1)	(1)	-----	(1)
Turkey:					
Coal	1,594	1,852	2,228	2,340	1,547
Lignite	14	30	53	73	79
U. S. S. R. (Russia):					
Coal	10,532	13,493	17,378		
Lignite	2,731	2,951	3,995	25,200	27,000
Sakhalin: Coal	276	327	436		
Africa:					
Algeria	25	30	34	38	7
Belgian Congo: Coal	17	20	5	11	(1)
Morocco, French	15	27	31	53	50

[1] Estimate included in total.
[2] Approximate production.
[3] Exclusive of mines in the Saar.
[4] Mines under French control until Mar. 1, 1935.
[5] Year ended Mar. 31 of year following that stated.

TABLE 43.—*Coal and lignite produced in the principal countries of the world in the calendar years 1932–36, in thousands of metric tons*—Continued

Country	1932	1933	1934	1935	1936
Africa—Continued.					
Nigeria	257	239	275	262	296
Portuguese East Africa	20	16	22	16	(1)
Southern Rhodesia	438	484	643	695	705
Union of South Africa	9,921	10,714	12,195	13,574	14,839
Oceania:					
Australia:					
New South Wales	6,893	7,233	8,000	8,838	8,838
Queensland	855	890	972	1,069	1,064
Tasmania	114	118	115	126	134
Victoria:					
Coal	439	531	363	427	427
Lignite	2,654	2,621	2,660	3,045	3,045
Western Australia	422	466	508	546	574
New Zealand:					
Coal	943	857	845	838	(1)
Lignite	928	993	1,248	1,311	(1)
Total, all grades	1,125,000	1,186,000	1,296,000	1,330,000	1,379,000
Lignite (total of items shown above)	173,000	178,000	190,000	203,000	222,000
Bituminous and anthracite (by subtraction)	952,000	1,008,000	1,106,000	1,127,000	1,157,000

[1] Estimate included in total.

DETAILED STATISTICS OF BITUMINOUS COAL, BY STATES AND COUNTIES

TABLES OF PRODUCTION, VALUE, MEN EMPLOYED, DAYS OPERATED, MAN-DAYS OF LABOR, AND OUTPUT PER MAN IN 1935

Table 44 presents detailed statistics for each coal-producing county from which three or more operators reported production. If less than three reports were received, the figures for two or more counties have been combined to avoid disclosing individual returns, unless permission to publish has been granted by the producers.

The series gives the details of total value of product, average value per ton, men employed above and below ground, average number of days worked by the mines, and output per man per day. The figures include stripping operations as well as deep mines. Separate particulars for the stripping operations in each county are given in table 21. If the reader will deduct the stripping figures as given in that table from the totals for all mines in the following table he will find that the remainder represents the operations of the deep mines. By this means figures can be obtained for the deep mines separately in any State or county desired.

In response to many requests for data on the amount of coal shipped from mine to consumer by motortruck, the Bureau of Mines in 1932 for the first time asked the mine operators to supply such information. For the last 3 years this tonnage has been shown as "Commercial sales by truck or wagon." (See column 2 of table 44 for 1935.)

Because of a change in the method of reporting, the statistics of average production per man per day for 1932 to 1935 are not precisely comparable with those for earlier years. Before 1932 they were based on the calculated number of man-shifts, obtained by multiplying the average number of men employed at each mine by the number of days worked at the mine. Since 1932, operators have been asked to make a special report of the number of man-shifts actually worked

wherever the necessary record was kept. The number of operators able to furnish this information was small, except in certain Far Western States. The reported man-shifts were utilized wherever possible to improve the accuracy of the record. Otherwise, the man-shifts were calculated by multiplying the number employed underground and on the surface by the number of days worked by the mine and tipple, respectively.

To facilitate comparisons with former years, the Bureau has also computed the output per man per day for 1935, using the calculated method throughout. The result for Alabama was 2.84 tons; Alaska, 5.13; Arizona, California, Idaho, and Oregon, 1.72; Arkansas, 2.53; Colorado, 4.43; Georgia and North Carolina, 1.30; Illinois, 6.27; Indiana, 8.46; Iowa, 2.84; Kansas, 4.32; Kentucky, 4.26; Maryland, 3.17; Michigan, 2.70; Missouri, 4.20; Montana, 9.62; New Mexico, 3.31; North Dakota, 8.15; Ohio, 4.46; Oklahoma, 3.24; Pennsylvania, bituminous, 4.11; South Dakota, 2.46; Tennessee, 3.06; Texas, 5.47; Utah, 7.10; Virginia, 3.93; Washington, 3.70; West Virginia, 4.78; and Wyoming, 6.37.

In this form, the 1935 figures are precisely comparable with those for the years prior to 1932.

TABLE 44.—*Production, value, men employed, days operated, man-days of labor, and output per man per day at bituminous-coal mines in specified States and counties in 1935*

[Note that figures relate only to active mines of commercial size, excluding wagon mines producing less than 1,000 tons. Waste and refuse are not included in tonnage. The statistics of average tons per man per day in 1935 are based upon (1) the reported number of man-shifts, where the operator keeps a record thereof; otherwise, upon (2) the calculated number of man-shifts, obtained by multiplying the average number of men employed underground and on the surface at each mine by the number of days worked by the mine and tipple, respectively. They are not precisely comparable with the figures published for the years prior to 1932, which were based on a calculated method throughout, but in most States the discrepancy is slight]

ALABAMA

County	Net tons					Value		Number of employees				Average number of days mines operated	Man-days of labor	Average tons per man per day
	Loaded at mines for shipment by rail or water	Commercial sales by truck or wagon	Other sales to local trade, or used by employees, or taken by locomotives at tipple	Used for power and heat or made into coke at mines	Total quantity	Total (thousand dollars)	Average per ton	Underground	Surface: In strip pits	Surface: All others	Total			
Bibb	444,117	3,754	2,801	8,682	459,354	$1,035	$2.25	981	------	150	1,131	160	181,201	2.54
Blount	96,288	11,899	143	1,000	109,330	235	2.15	279	11	48	338	177	59,875	1.83
Cullman	------	14,727	------	------	14,727	32	2.17	58	------	10	68	154	10,500	1.40
Jefferson	4,275,241	94,881	46,687	23,825	4,440,634	9,224	2.08	8,163	------	1,270	9,433	161	1,514,548	2.93
Marion	189,027	28,780	1,244	------	219,051	607	2.77	508	------	82	590	155	91,352	2.40
St. Clair	811,787	4,744	6,548	22,675	845,754	2,014	2.38	1,149	------	113	1,262	234	295,329	2.86
Shelby	344,639	46,938	1,865	1,413	394,855	1,002	2.54	870	------	194	1,064	160	170,240	2.32
Tuscaloosa	59,651	3,342	10	65	63,068	118	1.87	174	------	31	205	104	21,323	2.96
Walker	1,769,349	51,844	27,435	2,121	1,850,749	3,768	2.04	3,786	136	632	4,554	144	657,957	2.81
Other counties (Etowah, Fayette, Jackson, and Winston)	99,638	7,100	50	200	106,988	216	2.02	222	5	34	261	157	40,850	2.62
Total, 1935	8,089,737	268,009	86,783	[1] 59,981	8,504,510	18,251	2.15	16,190	152	2,564	18,906	161	3,043,175	2.79
Total, 1934	8,779,450	206,433	104,488	[1] 51,746	9,142,117	18,838	2.06	16,119	140	2,592	18,851	185	3,490,108	2.62

ALASKA

County	Loaded at mines for shipment by rail or water	Commercial sales by truck or wagon	Other sales	Used for power and heat or made into coke at mines	Total quantity	Total (thousand dollars)	Average per ton	Underground	In strip pits	All others	Total	Average number of days	Man-days of labor	Average tons per man per day
Total, 1935	112,260	------	5,971	[1] 1,194	119,425	$502	$4.20	60	------	35	95	249	24	5.05
Total, 1934	101,060	------	5,370	[1] 1,078	107,508	451	4.20	56	------	37	93	217	20	5.33

[1] No coal was made into coke at mines in 1934 or 1935.

TABLE 44.—*Production, value, men employed, days operated, man-days of labor, and output per man per day at bituminous-coal mines in specified States and counties in 1935*—Continued

County	Net tons					Value		Number of employees				Average number of days mines operated	Man-days of labor	Average tons per man per day
	Loaded at mines for shipment by rail or water	Commercial sales by truck or wagon	Other sales to local trade, or used by employees, or taken by locomotives at tipple	Used for power and heat or made into coke at mines	Total quantity	Total (thousand dollars)	Average per ton	Underground	Surface: In strip pits	Surface: All others	Total			
ARIZONA, CALIFORNIA, IDAHO, AND OREGON														
Total, 1935 [2]	7,472	8,420	7,932	[1] 1,020	24,844	$95	$3.82	82	-------	21	103	140	14	1.72
Total, 1934 [3]	17,050	10,907	7,239	[1] 3,000	38,196	143	3.74	73	-------	22	95	189	18	2.13
ARKANSAS														
Franklin	133,981	2,377	168	710	137,236	$392	$2.86	301	40	39	380	117	44,618	3.08
Johnson	147,657	400	179	540	148,776	469	3.15	590	-------	129	719	89	64,176	2.32
Logan	334,487	-------	750	2,555	337,792	1,192	3.53	935	-------	114	1,049	137	144,069	2.34
Pope	47,687	800	75	454	49,016	202	4.12	156	-------	15	171	157	26,789	1.83
Sebastian	446,975	4,653	1,211	7,620	460,459	1,193	2.59	1,236	2	186	1,424	126	179,308	2.57
Total, 1935	1,110,787	8,230	2,383	[1] 11,879	1,133,279	3,448	3.04	3,218	42	483	3,743	123	458,960	2.47
Total, 1934	832,588	8,211	807	[1] 14,826	856,432	2,564	2.99	2,926	52	437	3,415	102	347,475	2.46
COLORADO														
Boulder	217,883	255,739	3,989	21,162	498,773	$1,377	$2.76	628	-------	100	728	219	159,311	3.13
Delta	27,606	21,595	325	3,150	52,676	125	2.37	49	-------	21	70	166	11,618	4.53
Elbert	-------	6,254	85	415	6,754	12	1.78	11	8	4	23	137	3,140	2.15
El Paso	66,757	132,304	94,310	8,715	302,086	685	2.27	293	-------	70	363	234	84,824	3.56
Fremont	172,624	234,434	5,300	4,671	417,029	1,140	2.73	693	-------	119	812	191	155,097	2.69
Garfield	15,612	21,654	923	2,126	40,315	92	2.28	43	-------	11	54	202	10,924	3.69
Gunnison	456,361	22,230	3,006	9,657	491,254	958	1.95	472	-------	100	572	187	107,214	4.58
Huerfano	617,649	41,020	4,241	5,838	668,748	1,596	2.39	1,000	-------	224	1,224	158	193,945	3.45

Jefferson	109,948	24,816	1,062	1,707	137,533	291	2.12	122		22	144	226	32,564	4.22
La Plata	8,434	20,124	100	2	28,660	67	2.34	38		13	51	196	10,020	2.86
Las Animas	809,041	40,788	17,035	[4] 86,927	953,791	2,027	2.13	1,289		230	1,519	157	238,252	4.00
Mesa	25,775	38,651	1,293	36	65,755	133	2.02	81		22	103	194	20,029	3.28
Moffatt		6,804			6,804	15	2.24	7		2	9	233	2,100	3.24
Montezuma		7,298			7,298	17	2.33	16		4	20	189	3,779	1.93
Rio Blanco		4,518			4,518	9	1.99	7		1	8	186	1,491	3.03
Routt	733,866	21,127	3,882	31,030	789,905	1,934	2.45	767		197	964	167	161,407	4.89
Weld	1,096,664	262,227	14,188	35,296	1,408,375	3,137	2.23	1,273		163	1,436	170	244,474	5.76
Other counties (northern) (Jackson and Larimer)	20,094	5,568	186	648	26,496	52	1.96	22	12	8	42	122	5,139	5.16
Other counties (southern) (Montrose, Pitkin, and San Miguel)	1,167	2,524	50		3,741	8	2.13	9		2	11	145	1,590	2.35
Total 1935	4,379,481	1,169,675	149,975	211,380	5,910,511	13,675	2.31	6,820	20	1,313	8,153	177	1,446,918	4.08
Total 1934	3,976,652	982,316	62,971	188,994	5,210,933	[5] 12,063	[5] 2.31	6,722	22	1,350	8,094	158	1,277,656	4.08

GEORGIA AND NORTH CAROLINA [6]

Total, 1935	19,719	2,600	120	[1] 295	22,734	$58	$2.55	90		19	109	160	17	1.30
Total, 1934	32,494	2,290		[1] 1,072	35,856	89	2.48	105		26	131	190	25	1.44

ILLINOIS

Bond and Montgomery	552,701	48,091	6,520	14,735	622,047	$900	$1.45	660		104	764	146	111,880	5.56
Bureau	1,348	50,804	2,226	3,808	58,186	164	2.82	243	6	29	278	187	51,960	1.12
Christian	3,746,532	124,149	19,182	24,337	3,914,200	5,868	1.50	1,913		586	2,499	186	464,224	8.43
Clinton	126,912	98,379	5,840	12,287	243,418	358	1.47	425		56	481	114	54,708	4.45
Edgar		35,542	87	507	36,136	61	1.69	42		9	51	178	9,072	3.98
Franklin	7,697,407	25,715	53,979	101,454	7,878,555	12,345	1.57	5,378		1,268	6,646	169	1,124,737	7.00
Fulton	1,819,577	333,650	4,466	8,734	2,166,427	3,034	1.40	828	300	277	1,405	188	263,726	8.21
Gallatin		41,460		1,470	42,930	75	1.75	50		11	61	162	9,885	4.34
Greene		6,051	16		6,067	15	2.47	27		7	34	142	4,811	1.26
Grundy		128,668	113	1,064	129,845	317	2.44	180	11	17	208	145	30,068	4.32
Hancock and McDonough		2,365	12	6	2,383	6	2.52	4	13	3	20	86	1,710	1.39
Henry	497,081	166,247	3,562	9,648	676,538	1,143	1.69	371	49	124	544	189	102,862	6.58
Jackson	1,252,755	55,120	7,179	4,240	1,319,294	1,883	1.43	539	269	191	999	148	147,876	8.92
Knox	233,909	144,908	2,193	2,080	383,090	862	2.25	407		56	463	200	92,630	4.14
LaSalle	92,630	225,603	105,785	1,401	425,419	1,071	2.52	589	126	76	791	204	161,172	2.64
Livingston		18,231	481	380	19,092	60	3.14	47	8	12	67	172	11,506	1.66

[1] No coal was made into coke at mines in 1934 or 1935.
[2] Coconino and Navajo Counties, Ariz.; Amador, Monterey, and Trinity Counties, Calif.; Teton County, Idaho; Coos County, Oreg.
[3] Coconino and Navajo Counties, Ariz.; Amador, Monterey, Santa Cruz, and Trinity Counties, Calif.; Owyhee and Teton Counties, Idaho; Coos County, Oreg.
[4] Includes 75,810 tons made into coke at mines in Las Animas County in 1935 (58,011 tons in 1934).
[5] Revised figures.
[6] Walker County, Ga.; Moore County, N. C.

TABLE 44.—*Production, value, men employed, days operated, man-days of labor, and output per man per day at bituminous-coal mines in specified States and counties in 1934*—Continued

ILLINOIS—Continued

County	Net tons: Loaded at mines for shipment by rail or water	Net tons: Commercial sales by truck or wagon	Net tons: Other sales to local trade, or used by employees, or taken by locomotives at tipple	Net tons: Used for power and heat or made into coke at mines	Net tons: Total quantity	Value: Total (thousand dollars)	Value: Average per ton	Number of employees: Underground	Number of employees: Surface: In strip pits	Number of employees: Surface: All others	Number of employees: Total	Average number of days mines operated	Man-days of labor	Average tons per man per day
Macoupin	3,401,358	85,854	35,746	120,352	3,643,310	$4,654	$1.28	2,362		322	2,684	222	595,507	6.12
Madison	1,063,705	556,666	10,859	59,049	1,690,279	2,418	1.43	1,500	26	266	1,792	166	297,522	5.68
Marshall		9,096			9,096	21	2.31	33		8	41	113	4,618	1.97
Menard		129,004	3,362	4,246	136,612	258	1.89	156		21	177	207	36,702	3.72
Mercer		28,096	240	1,780	30,116	78	2.59	64		12	76	156	11,820	2.55
Peoria	1,148,240	357,353	3,289	3,124	1,512,006	2,562	1.69	1,587	5	137	1,729	189	326,372	4.63
Perry	3,173,187	49,249	42,707	28,704	3,293,847	4,432	1.35	1,174	633	298	2,105	171	360,941	9.13
Randolph	446,043	88,284	9,341	15,839	559,507	878	1.57	782		116	898	114	102,712	5.45
Rock Island		70,959	35		70,994	190	2.68	115		14	129	188	24,249	2.93
St. Clair	1,157,239	1,243,626	39,490	63,178	2,503,533	3,596	1.44	2,651	56	415	3,122	148	462,799	5.41
Saline	2,959,688	54,384	46,246	70,891	3,131,209	5,458	1.74	3,321	107	440	3,868	155	600,291	5.22
Sangamon	1,996,007	442,677	41,890	23,347	2,503,921	3,994	1.60	3,217		334	3,551	157	559,131	4.48
Schuyler		60,479	10	724	61,213	110	1.80	107	12	25	144	173	24,901	2.46
Shelby	280	23,288	1,400	225	25,193	88	3.49	150	3	27	180	108	19,524	1.29
Stark		15,740	890	55	16,685	39	2.34	38		12	50	167	8,372	1.99
Tazewell	69,038	217,625		2,764	289,427	605	2.09	427		47	474	173	81,910	3.53
Vermilion	1,572,761	312,654	82,107	10,429	1,977,951	3,471	1.75	2,184	59	252	2,495	181	450,589	4.39
Wabash		14,478	161	1,450	16,089	27	1.68	36		6	42	176	7,372	2.18
Warren		6,032	250		6,282	13	2.07	20		4	24	119	2,853	2.20
Washington	282,904	44,193	27,403	24,722	379,222	590	1.56	314		64	378	179	67,521	5.62
Williamson	2,589,639	275,618	23,179	56,141	2,944,577	4,414	1.50	2,007	163	453	2,623	173	453,034	6.50
Other counties (Cass, Crawford, Macon, Marion, Putnam, Scott, White, Will, and Woodford)	1,273,134	459,821	28,856	38,962	1,800,773	3,458	1.92	1,323	286	246	1,855	172	318,145	5.66
Total 1935	37,154,075	6,050,159	609,102	[1] 712,133	44,525,469	69,516	1.56	35,271	2,132	6,345	[7] 43,748	171	7,459,712	[10] 5.97
Total 1934	35,023,844	4,781,525	774,651	[1] 692,364	41,272,384	64,238	1.56	37,612	1,731	6,724	46,067	160	7,350,348	[8] 5.62

INDIANA

Clay	841,459	201,840	2,489	13,161	1,058,949	$1,796	$1.70	192	392	145	729	188	137,039	7.73
Daviess		24,307	700	800	25,807	46	1.78	43		13	56	178	9,945	2.59
Gibson	1,097,151	79,959	5,679	22,545	1,205,334	1,789	1.48	566		175	741	174	128,881	9.35
Greene	1,554,036	25,445	6,436	18,502	1,604,419	2,550	1.59	502	318	176	996	185	184,045	8.72
Knox	1,405,605	127,992	46,104	16,495	1,596,196	2,301	1.44	933		225	1,158	182	210,855	7.57
Owen	137,925	3,375	50	330	141,680	265	1.87		74	12	86	169	14,541	9.74
Parke		31,645	1,825	680	34,150	80	2.34	49		8	57	146	8,314	4.11
Perry and Spencer		11,128	26		11,154	14	1.26	15		2	17	236	4,005	2.79
Pike	2,700,356	10,060	530	17,821	2,728,767	3,353	1.23	94	620	198	912	203	185,381	14.72
Sullivan	2,188,144	26,759	8,378	38,406	2,261,687	3,840	1.70	1,544	130	374	2,048	173	354,057	6.39
Vermillion	956,705	100,834	1,657	32,584	1,091,780	1,717	1.57	1,059	67	202	1,328	152	201,416	5.42
Vigo	2,307,513	165,893	371,456	47,942	2,892,804	4,622	1.60	1,759	195	324	2,278	183	416,453	6.95
Warrick	863,871	82,393	6,702	12,550	965,516	1,176	1.22	266	241	126	633	159	100,855	9.57
Other counties (Fountain, Vanderburg, and Warren)	45,700	84,972	100	5,199	135,971	173	1.27	259		49	308	116	35,804	3.80
Total 1935	14,098,465	976,602	452,132	[1] 227,015	15,754,214	23,722	1.51	7,281	2,037	2,029	[10] 11,347	176	1,991,591	[9] 7.91
Total 1934	13,307,212	771,011	499,549	[1] 215,871	14,793,643	21,838	1.48	7,425	1,736	2,012	11,173	171	1,909,290	[8] 7.75

IOWA

Adams		23,136		20	23,156	$76	$3.28	128		25	153	119	18,230	1.27
Appanoose	467,738	116,034	14,343	396	598,511	1,423	2.38	1,596		155	1,751	142	247,881	2.41
Boone	308,770	115,107	9,665	4,573	438,115	1,180	2.69	947		79	1,026	183	187,986	2.33
Dallas	287,718	72,873	6,565	1,331	368,487	887	2.41	602		37	639	198	120,195	3.07
Davis and Jefferson		6,950		30	6,980	19	2.72	20		4	24	130	3,110	2.24
Greene		54,341	80	35	54,456	152	2.79	84	17	13	114	118	13,395	4.07
Guthrie		23,143	20	69	23,232	79	3.40	76		10	86	180	15,472	1.50
Jasper		43,797	989	1,188	45,974	120	2.61	151		20	171	98	16,773	2.74
Keokuk		8,324	100		8,424	17	2.02	14	10	5	29	135	3,928	2.14
Lucas	466,182	7,926	3,337	4,643	482,088	1,060	2.20	664		67	731	175	127,716	3.77
Mahaska	44,664	63,582	60	1,097	109,403	219	2.00	92	36	36	164	158	25,836	4.23
Marion	122,878	194,927	6,900	6,420	331,125	795	2.40	605	81	114	800	163	130,301	2.54

[1] No coal was made into coke at mines in 1934 or 1935.

[7] The figures of number of men employed in 1935 are not strictly comparable with those for 1934. In Illinois during recent years from 28 to 45 mines have divided the available working time among their employees. In 1934 some of these mines reported to the Bureau the average number of men working when the mines were active, and others the total number on the rolls, so that the aggregate number reported for that year was approximately 1,600 in excess of the average number actually working. For 1935 the figures represent the average number working. If all men on the pay rolls of the mines dividing work are included, the total number of men employed in 1935 is found to be 46,129.

[8] Much of the output of the State is obtained from strip pits or by the use of loading machines, in which types of operations the production per man is large.

[9] The indicated increase in output per man-day in 1935 is partly due to the activity of strip mines, and partly to more accurate measurement of the number of man-days at certain underground mines where the available working time was divided among the men on the rolls. If allowance is made for these factors, the actual increase in output per man-day at deep mines was slight.

[10] The figures of number of men employed in 1935 may not be strictly comparable with those for 1934, because of differences in reporting at certain mines which divided working time among their employees by local agreement. The 1935 figures here given represent in all cases the average number of men working, rather than the total number on the rolls, so far as disclosed by the information at hand. If all men on the pay rolls of the mines dividing work were included, the aggregate number employed in 1935 would be somewhat greater than the 11,347 here shown.

TABLE 44.—*Production, value, men employed, days operated, man-days of labor, and output per man per day at bituminous-coal mines in specified States and counties in 1935*—Continued

IOWA—Continued

County	Net tons: Loaded at mines for shipment by rail or water	Net tons: Commercial sales by truck or wagon	Net tons: Other sales to local trade, or used by employees, or taken by locomotives at tipple	Net tons: Used for power and heat or made into coke at mines	Net tons: Total quantity	Value: Total (thousand dollars)	Value: Average per ton	Number of employees: Underground	Number of employees: Surface: In strip pits	Number of employees: Surface: All others	Number of employees: Total	Average number of days mines operated	Man-days of labor	Average tons per man per day
Monroe	240,313	30,270		2,558	273,141	$580	$2.12	526		52	578	147	84,729	3.22
Page	3,640	42,803	3,350		49,793	174	3.49	107		12	119	193	22,966	2.17
Polk	77,201	413,873	4,593	5,716	501,383	1,270	2.53	827		87	914	181	165,834	3.02
Van Buren		13,196	64	537	13,797	36	2.61	36	3	5	44	193	8,489	1.63
Wapello	2,750	78,878	475	680	82,783	226	2.73	203	2	38	243	141	34,183	2.42
Warren	36,744	120,025	790	4,400	161,959	447	2.76	162	49	29	240	161	38,666	4.19
Wayne		9,832	207	2	10,041	23	2.29	36		5	41	115	4,733	2.12
Webster		46,893	31	1,397	48,321	151	3.12	75	21	16	112	208	23,256	2.08
Other counties (Hamilton, Scott, and Taylor)	551	16,358	2,085		18,994	68	3.58	47	4	8	59	207	12,230	1.55
Total, 1935	2,059,149	1,502,268	53,654	[1] 35,092	3,650,163	9,002	2.47	6,998	223	817	8,038	162	1,305,909	2.80
Total, 1934	2,011,749	1,263,483	50,384	[1] 41,376	3,366,992	7,862	2.34	6,687	281	753	7,721	156	1,204,253	2.80

KANSAS

County	Net tons: Loaded at mines for shipment by rail or water	Net tons: Commercial sales by truck or wagon	Net tons: Other sales to local trade, or used by employees, or taken by locomotives at tipple	Net tons: Used for power and heat or made into coke at mines	Net tons: Total quantity	Value: Total (thousand dollars)	Value: Average per ton	Number of employees: Underground	Number of employees: Surface: In strip pits	Number of employees: Surface: All others	Number of employees: Total	Average number of days mines operated	Man-days of labor	Average tons per man per day
Bourbon		20,515			20,515	$34	$1.66		31	3	34	166	5,628	3.65
Cherokee	277,810	33,688	298	740	312,536	573	1.83	156	84	63	303	171	51,822	6.03
Crawford	1,985,361	123,477	3,628	8,459	2,120,925	3,790	1.79	1,341	746	272	2,359	158	372,620	5.69
Franklin		23,468			23,468	70	2.98	57	10	9	76	190	14,460	1.62
Labette	3,000	12,921		550	16,471	33	2.00		21	4	25	163	4,068	4.05
Linn	1,940	22,743	197	326	25,206	49	1.94	81	34	22	137	107	14,698	1.71
Osage	21,951	63,267	381		85,599	266	3.11	354	52	40	446	126	56,176	1.52
Other counties (Coffey and Leavenworth) [11]	78,519	2,925			81,444	128	[12] 1.57	407	12	97	516	296	152,733	.53
Total, 1935	2,368,581	303,004	4,504	[1] 10,075	2,686,164	4,943	[12] 1.84	2,396	990	510	3,896	173	672,205	[13] 4.00
Total, 1934	2,256,220	233,628	6,579	[1] 11,827	2,508,254	4,619	1.84	2,402	954	388	3,744	151	563,712	4.45

KENTUCKY

Eastern district:														
Bell	1,191,421	32,865	35,731	3,605	1,263,622	$2,129	$1.68	2,225		297	2,522	148	372,491	3.39
Boyd	18,716	12,811	542		32,069	59	1.84	99		22	121	112	13,602	2.36
Breathitt	25,102	42,031	250	2,150	69,533	131	1.88	154		24	178	144	25,655	2.71
Carter		11,710			11,710	24	2.05	35		9	44	154	6,765	1.73
Clay	67,270	6,471			73,741	103	1.40	155		26	181	209	37,816	1.95
Floyd	3,732,025	300	14,161	9,259	3,755,745	6,549	1.74	4,244		716	4,960	192	949,852	3.95
Greenup		6,491			6,491	12	1.85	14		3	17	168	2,860	2.27
Harlan	12,021,099	23,863	57,424	13,088	12,115,474	21,304	1.76	10,744		1,756	12,500	224	2,799,545	4.33
Jackson		33,256			33,256	49	1.47	88		14	102	186	18,938	1.76
Johnson	612,595	140	6,534	6,946	626,215	1,261	2.01	742		108	850	185	157,148	3.98
Knott	380,283		672		380,955	635	1.67	401		64	465	180	83,801	4.55
Knox	476,946	5,533	4,270	11,000	497,749	766	1.54	476		109	585	194	113,279	4.39
Laurel		24,916	325		25,241	50	1.98	87		23	110	163	17,876	1.41
Lee	400	9,819		300	10,519	19	1.81	39		6	45	147	6,620	1.59
Letcher	4,271,710	1,389	42,457	62,144	4,377,700	7,469	1.71	4,759		662	5,421	203	1,099,948	3.98
Martin	223,018	1,100	2,095		226,213	358	1.58	289		55	344	133	45,846	4.93
Perry	3,585,168	50	78,733		3,663,951	6,260	1.71	3,997		836	4,833	173	836,473	4.38
Pike	4,656,807	25,509	27,432	27,129	4,736,877	7,832	1.65	4,545		848	5,393	192	1,036,476	4.57
Rockcastle		7,050			7,050	10	1.42	23		5	28	102	2,860	2.47
Whitley	232,657	500	4,343	9,150	246,650	477	1.93	559		141	700	127	88,793	2.78
Other counties (Lawrence, McCreary, Magoffin, Pulaski, Wayne, and Wolfe)	439,092	9,719	6,665	10,580	466,056	852	1.83	1,041		188	1,229	107	131,475	3.54
Total 1935	31,934,309	255,523	281,634	155,351	32,626,817	56,349	1.73	34,716		5,912	40,628	193	7,848,119	4.16
Total 1934	29,710,936	202,960	261,424	135,136	30,310,456	50,827	1.68	32,570		5,879	38,449	190	7,288,298	4.16
Western district:														
Christian	30,044	8,101	57		38,202	54	1.41	119	15	43	177	65	11,565	3.30
Daviess		117,416	381	1,255	119,052	138	1.16	144		30	174	209	36,303	3.28
Henderson	105,025	89,099	2,052	12,233	208,409	308	1.48	360		67	427	177	75,652	2.75
Hopkins	2,861,392	76,143	23,850	8,684	2,970,069	3,629	1.22	3,163		419	3,582	171	613,069	4.84
McLean	40,000	6,182	2,000	128	48,310	56	1.16	61		15	76	179	13,630	3.54
Muhlenberg	2,054,841	54,083	44,471	58,297	2,211,692	2,509	1.13	3,303		505	3,808	107	407,615	5.43
Ohio	413,981	16,952	2,430	4,383	437,746	461	1.05	754		126	880	103	90,889	4.82
Union	557,752	60,071	9,372	17,103	644,298	784	1.22	723		117	840	167	140,448	4.59

[1] No coal was made into coke at mines in 1934 or 1935.

[11] Production of 1 mine, the tipple of which is in Leavenworth County, Kans., is credited to Platte County, Mo., where the workings are located.

[12] The average value per ton for Leavenworth County is affected by the mine of the State Penitentiary, the reported production of which in recent years has previously been carried at a nominal value equal to that of nearby commercial mines. In 1935, for the first time since 1931, the penitentiary mine reported its value but at a much lower figure. If this mine were carried at the same per-ton value as in 1934, the average value for the State in 1935 would be $1.88, an increase of $0.04 over the year before.

[13] The apparent decrease in output per man per day in 1935 affects chiefly stripping mines and is due to more complete allowance for the man-days of labor engaged in operation of stripping shovels or other work inside the pits on days when the tipples were idle.

TABLE 44.—*Production, value, men employed, days operated, man-days of labor, and output per man per day at bituminous-coal mines in specified States and counties in 1935*—Continued

KENTUCKY—Continued

County	Net tons					Value		Number of employees				Average number of days mines operated	Man-days of labor	Average tons per man per day
	Loaded at mines for shipment by rail or water	Commercial sales by truck or wagon	Other sales to local trade, or used by employees, or taken by locomotives at tipple	Used for power and heat or made into coke at mines	Total quantity	Total (thousand dollars)	Average per ton	Underground	Surface: In strip pits	Surface: All others	Total			
Webster	1,391,454	30,330	6,015	10,215	1,438,014	$1,642	$1.14	1,436		229	1,665	164	273,257	5.26
Other counties (Butler and Hancock)	4,556	13,764	10		18,330	26	1.42	68		14	82	111	9,061	2.02
Total 1935	7,459,045	472,141	90,638	112,298	8,134,122	9,607	1.18	10,131	15	1,565	11,711	143	1,671,489	4.87
Total 1934	7,573,024	398,671	122,947	120,137	8,214,779	9,721	1.18	9,625		1,435	11,060	145	1,607,449	5.11
Total all Kentucky, 1935	39,393,354	727,664	372,272	[1] 267,649	40,760,939	65,956	1.62	44,847	15	7,477	52,339	182	9,519,608	4.28
Total all Kentucky, 1934	37,283,960	601,631	384,371	[1] 255,273	38,525,235	60,548	1.57	42,195		7,314	49,509	180	8,895,747	4.33
MARYLAND														
Allegany	1,022,254	213,957	18,511	2,695	1,257,417	$2,499	$1.99	1,955		230	2,185	193	421,888	2.98
Garrett	381,842	30,022	2,257	6,521	420,642	767	1.82	656		121	777	138	107,211	3.92
Total 1935	1,404,096	243,979	20,768	[1] 9,216	1,678,059	3,266	1.95	2,611		351	2,962	179	529,099	3.17
Total 1934	1,403,154	137,764	78,160	[1] 8,034	1,627,112	3,089	1.90	2,617		359	2,976	176	522,288	3.12
MICHIGAN														
Bay	54,045	51,474	3,169	10,498	119,186	$371	$3.11	294		47	341	145	49,448	2.41
Saginaw	43,384	94,327	2,950	5,206	145,867	477	3.27	291		64	355	147	52,352	2.79
Shiawassee		106,812	2,119	3,100	112,031	349	3.12	206	34	28	268	161	43,178	2.59

Other counties (Eaton, Genesee, Ingham, Midland, and Tuscola)	166, 199	70, 040	4, 721	10, 340	251, 300	820	3 26	436	-------	67	503	174	87, 333	2. 88
Total 1935	263, 628	322, 653	12, 959	1 29, 144	628, 384	2, 017	3. 21	1, 227	34	206	1, 467	158	232, 311	2. 70
Total 1934	324, 509	260, 640	10, 830	1 25, 762	621, 741	1, 940	3. 12	1, 274	57	225	1, 556	157	244, 813	2. 54
MISSOURI														
Adair	121, 433	35, 153	1, 465	3, 908	161, 959	$315	$1. 94	245	-------	29	274	204	56, 025	2. 89
Audrain	-------	5, 243	-------	-------	5, 243	14	2. 67	35	-------	5	40	147	5, 895	. 89
Barton	690, 163	4, 373	2, 334	-------	696, 870	1, 166	1. 67	5	178	70	253	203	51, 272	14 13. 59
Bates	692, 061	21, 242	110	375	713, 788	1, 159	1. 62	48	240	64	352	199	70, 201	14 10. 17
Boone	-------	25, 993	50	10	26, 053	51	1. 96	77	14	16	107	132	14, 170	1. 84
Callaway	-------	30, 794	6, 485	437	37, 716	82	2. 17	37	28	9	74	192	14, 194	2. 66
Chariton	-------	2, 947	40	5	2, 992	6	2. 01	11	-------	3	14	87	1, 220	2. 45
Clay	18, 684	74, 914	2, 978	1, 311	97, 887	286	2. 92	367	-------	60	427	161	68, 869	1. 42
Dade and Jasper	-------	16, 880	10	-------	16, 890	38	2. 25	2	19	1	22	252	5, 540	3. 05
Henry	421, 495	46, 179	31, 321	7, 426	506, 421	925	1. 83	33	223	39	295	185	54, 642	14 9. 27
Johnson	-------	6, 676	-------	150	6, 826	16	2. 34	19	7	4	30	143	4, 299	1. 59
Lafayette	203, 336	91, 154	5, 522	3, 024	303, 036	700	2. 31	935	-------	74	1, 009	154	155, 688	1. 95
Lincoln, Ralls, and Warren	3, 529	7, 950	179	-------	11, 658	27	2. 32	36	2	9	47	178	8, 352	1. 40
Linn	31, 234	24, 483	494	-------	56, 211	131	2. 33	264	-------	22	286	147	42, 050	1, 34
Macon	20, 893	25, 377	1, 130	2, 238	49, 638	85	1. 71	190	-------	83	273	84	23, 067	2. 15
Putnam	-------	35, 803	-------	-------	35, 803	58	1. 62	147	-------	31	178	115	20, 534	1. 74
Randolph	450, 360	33, 455	5, 498	5	489, 318	843	1. 72	287	75	73	435	206	89, 478	14 5. 47
Ray	167, 632	111, 655	5, 025	292	284, 604	710	2. 49	1, 109	-------	148	1, 257	136	170, 579	1. 67
Vernon	67, 377	21, 283	1, 615	1, 725	92, 000	153	1. 66	25	77	17	119	131	15, 566	14 5. 91
Other counties (Caldwell, Grundy, Harrison, and Platte) 11	7, 904	38, 682	1, 516	2, 981	51, 083	159	3. 11	196	-------	22	218	162	35, 303	1. 45
Total 1935	2, 896, 101	660, 236	65, 772	1 23, 887	3, 645, 996	6, 924	1. 90	4, 068	863	779	5, 710	159	906, 944	4. 02
Total 1934	2, 738, 697	558, 818	31, 291	1 23, 477	3, 352, 283	6, 278	1. 87	4, 070	780	690	5, 540	141	780, 673	4. 29
MONTANA														
Blaine	-------	13, 176	-------	-------	13, 176	$42	$3. 19	15	-------	5	20	199	3, 983	3. 31
Carbon	301, 631	14, 597	4, 429	1, 072	321, 729	527	1. 64	216	-------	97	313	177	61, 355	5. 24
Cascade	360, 912	47, 581	1, 957	113	410, 563	610	1. 49	300	-------	45	345	215	74, 176	5. 53
Chouteau	-------	4, 878	12	25	4, 915	16	3. 26	11	-------	3	14	138	1, 928	2. 55
Daniels and Valley	-------	14, 172	88	36	14, 296	25	1. 75	20	6	5	31	187	5, 799	2. 47
Dawson and Wibaux	-------	7, 859	40	10	7, 909	11	1. 39	6	-------	2	8	223	1, 784	4. 43
Fergus	-------	3, 525	-------	-------	3, 525	14	3. 97	11	-------	1	12	164	1, 970	1. 79
Hill	-------	4, 540	270	130	4, 940	14	2. 83	13	-------	4	17	203	3, 450	1. 43
Judith Basin	-------	1, 847	164	-------	2, 011	6	2. 98	11	-------	2	13	109	1, 411	1. 43
Musselshell	772, 781	12, 941	1, 307	1, 914	788, 943	1, 318	1. 67	473	-------	141	614	171	104, 938	7. 52

1 No coal was made into coke at mines in 1934 or 1935.
11 Production of 1 mine, the tipple of which is in Leavenworth County, Kans., is credited to Platte County, Mo., where the workings are located.
14 The output is chiefly obtained from strip pits in which the production per man per day is large.

TABLE 44.—*Production, value, men employed, days operated, man-days of labor, and output per man per day at bituminous-coal mines in specified States and counties in 1935*—Continued

MONTANA—Continued

County	Net tons					Value		Number of employees				Average number of days mines operated	Man-days of labor	Average tons per man per day
	Loaded at mines for shipment by rail or water	Commercial sales by truck or wagon	Other sales to local trade, or used by employees, or taken by locomotives at tipple	Used for power and heat or made into coke at mines	Total quantity	Total (thousand dollars)	Average per ton	Underground	Surface: In strip pits	Surface: All others	Total			
Pondera and Toole		2,030	114		2,144	$12	$5.60	9		2	11	234	2,570	0.83
Richland	9,000	7,615	965		17,580	40	2.28	24	3	8	35	148	5,182	3.39
Roosevelt		4,060	50		4,110	8	1.95	9		2	11	152	1,670	2.46
Rosebud	1,141,494		1,625		1,143,119	1,467	1.28	4	47	17	68	254	17,286	[14] 66.13
Sheridan		15,838	100	35	15,973	24	1.50	23		6	29	199	5,758	2.77
Other counties (Gallatin, Golden Valley, and Park)		3,920	53		3,973	12	3.02	25		5	30	108	3,250	1.22
Total 1935	2,585,818	158,579	11,174	[1] 3,335	2,758,906	4,146	1.50	1,170	56	345	1,571	189	296,510	9.30
Total 1934	2,411,093	133,972	13,031	[1] 7,606	2,565,702	3,997	1.56	1,158	50	382	1,590	166	263,591	9.73

NEW MEXICO

County	Loaded at mines for shipment by rail or water	Commercial sales by truck or wagon	Other sales to local trade, or used by employees, or taken by locomotives at tipple	Used for power and heat or made into coke at mines	Total quantity	Total (thousand dollars)	Average per ton	Underground	Surface: In strip pits	Surface: All others	Total	Average number of days mines operated	Man-days of labor	Average tons per man per day
Colfax	685,470	17,354	5,995	2,096	710,915	$1,876	$2.64	791		168	959	164	157,093	4.53
Lincoln and Socorro		2,940	10		2,950	9	3.05	12		3	15	223	3,340	.88
McKinley	452,245	28,799	13,095	26,325	520,464	1,340	2.57	785		200	985	184	181,668	2.86
Rio Arriba	23,017	2,000	66	192	25,275	54	2.14	37		14	51	202	10,283	2.46
San Juan		7,600			7,600	20	2.63	13		2	15	264	3,965	1.92
Sandoval and Santa Fe	103,046	3,996	3,739	10,892	121,673	382	3.14	253		77	330	238	78,578	1.55
Total 1935	1,263,778	62,689	22,905	[1] 39,505	1,388,877	3,681	2.65	1,891		464	2,355	185	434,927	3.19
Total 1934	1,150,825	40,656	28,029	[1] 39,813	1,259,323	3,402	2.70	1,855		487	2,342	164	383,341	3.29

NORTH DAKOTA (LIGNITE)

Adams	3,200	18,778	10	20	22,008	$28	$1.27	21	10	5	36	174	6,261	3.52
Bowman	1,457	16,575			18,032	20	1.11	18	7	8	33	130	4,284	4.21
Burke	167,715	41,965	50	50	209,780	252	1.20		96	16	112	246	27,591	[14] 7.60
Burleigh	194,375	37,414	214	50	232,053	287	1.24	46	44	23	113	224	25,354	[14] 9.15
Divide	181,377	24,903		10	206,290	264	1.28	14	50	12	76	191	14,495	[14] 14.23
Grant	3,906	20,344			24,250	30	1.24	8	9	9	26	193	5,026	4.82
Hettinger		17,580	163		17,743	23	1.30	7	28	5	40	142	5,684	3.12
McLean	65,019	52,216	2,061	148	119,444	162	1.36	61	59	29	149	158	23,539	5.07
Mercer	513,560	2,705	4,608	3,600	524,473	636	1.21	204	55	80	339	169	57,191	[14] 9.17
Morton	12,361	12,300	34	3,000	27,695	40	1.44	29	9	5	43	111	4,792	5.78
Mountrail	223	8,498	25		8,746	12	1.37	15	5	4	24	154	3,698	2.37
Stark	5,210	19,391	65,124	830	90,555	102	1.13	54	3	15	72	262	18,852	4.80
Ward	285,385	125,130	590	440	411,545	472	1.15	134	42	45	221	212	46,785	[14] 8.80
Williams	1,806	28,500	1,170	20	31,496	55	1.75	50		13	63	159	10,004	3.15
Other counties (Dunn, Golden Valley, McKenzie, and Oliver)	340	10,780	280		11,400	12	1.05	7	7	4	18	183	3,292	3.46
Total 1935	1,435,934	437,079	74,329	[1] 8,168	1,955,510	2,395	1.22	668	424	273	1,365	188	256,848	7.61
Total 1934	1,281,830	347,306	64,193	[1] 60,559	1,753,888	2,363	1.35	728	437	353	1,518	174	263,730	6.65

OHIO

Athens	2,320,951	36,892	12,032	23,301	2,393,176	$4,120	$1.72	4,090		494	4,584	129	593,475	4.03
Belmont	5,567,596	125,884	121,217	17,555	5,832,252	8,995	1.54	6,602		668	7,270	167	1,213,395	4.81
Carroll	111,619	104,406	4,887	125	221,037	409	1.85	386		49	435	152	66,039	3.35
Columbiana	175,227	122,461	3,576	3,716	304,980	522	1.71	365	41	57	463	152	70,156	4.35
Coshocton	87,579	123,214	5,829	780	217,402	378	1.74	349	14	55	418	162	67,738	3.21
Gallia		22,788	25		22,813	46	2.02	51		9	60	166	9,966	2.29
Guernsey	1,061,535	97,591	8,041	3,530	1,170,697	1,949	1.66	1,465		140	1,605	186	298,242	3.93
Harrison	2,422,597	41,352	2,384	30,640	2,496,973	3,960	1.59	1,461	314	296	2,071	202	418,492	5.97
Hocking	205,967	83,876	1,527		291,370	529	1.82	596	7	93	696	112	78,041	3.73
Holmes		43,901	4,414	140	48,455	110	2.27	52	10	16	78	206	16,042	3.02
Jackson	184,532	76,002	25,058	4	285,596	517	1.81	225	70	69	364	164	59,638	4.79
Jefferson	3,250,397	283,172	40,752	16,310	3,590,631	5,797	1.61	3,529	199	464	4,192	177	741,405	4.84
Lawrence	916	73,979	6,171	50	81,116	151	1.86	161		30	191	146	27,921	2.91
Mahoning	50	75,323	15,559	6,143	97,075	228	2.35	220		34	254	160	40,515	2.40
Medina		4,981	3,865	1,465	10,311	34	3.30	15		4	19	212	4,035	2.56
Meigs	287,787	55,005	140	10	342,942	614	1.79	660		72	732	137	100,527	3.41
Morgan and Washington	399,259	1,099	811	624	401,793	713	1.77	609		65	674	154	103,923	3.87
Muskingum	491,311	104,913	1,850	4,676	602,750	1,097	1.82	504	77	137	718	191	137,425	4.39
Noble	181,784	2,533	1,668	6,900	192,885	315	1.63	507		37	544	87	47,471	4.06
Perry	602,021	118,406	3,423	178	724,028	1,237	1.71	1,150	34	149	1,333	148	196,976	3.68
Portage		17,033	500		17,533	49	2.79	42	3	8	53	144	7,654	2.29
Scioto		5,614	35		5,649	11	1.95	16		5	21	144	3,025	1.87

[1] No coal was made into coke at mines in 1934 or 1935.
[14] The output is chiefly obtained from strip pits, in which the production per man per day is large.

TABLE 44.—*Production, value, men employed, days operated, man-days of labor, and output per man per day at bituminous-coal mines in specified States and counties in 1935*—Continued

OHIO—Continued

County	Net tons: Loaded at mines for shipment by rail or water	Net tons: Commercial sales by truck or wagon	Net tons: Other sales to local trade, or used by employees, or taken by locomotives at tipple	Net tons: Used for power and heat or made into coke at mines	Net tons: Total quantity	Value: Total (thousand dollars)	Value: Average per ton	Number of employees: Underground	Number of employees: Surface: In strip pits	Number of employees: Surface: All others	Number of employees: Total	Average number of days mines operated	Man-days of labor	Average tons per man per day
Stark	17,219	468,231	36,947	1,313	523,710	$1,047	$2.00	662	50	89	801	182	146,080	3.59
Summit		17,086	8,050	1,895	27,031	53	1.96	60		6	66	159	10,473	2.58
Tuscarawas	435,280	572,189	146,002	2,721	1,156,192	2,050	1.77	1,475	20	194	1,689	170	287,126	4.03
Vinton	64,193	22,368	170	724	87,455	165	1.89	85	32	39	156	128	19,927	4.39
Wayne		6,784	450	65	7,299	15	2.06	32		5	37	68	2,510	2.91
Total 1935	17,867,820	2,707,083	455,383	[1] 122,865	21,153,151	35,111	1.66	25,369	871	3,284	29,524	162	4,768,217	[13] 4.44
Total 1934	17,813,518	2,239,110	511,540	[1] 126,396	20,690,564	[5] 35,291	[5] 1.71	24,811	776	3,660	29,247	167	4,892,512	4.23

OKLAHOMA

County	Net tons: Loaded at mines for shipment by rail or water	Net tons: Commercial sales by truck or wagon	Net tons: Other sales to local trade, or used by employees, or taken by locomotives at tipple	Net tons: Used for power and heat or made into coke at mines	Net tons: Total quantity	Value: Total (thousand dollars)	Value: Average per ton	Number of employees: Underground	Number of employees: Surface: In strip pits	Number of employees: Surface: All others	Number of employees: Total	Average number of days mines operated	Man-days of labor	Average tons per man per day
Coal	23,176	7,483	25	395	31,079	$124	$3.99	80		11	91	189	17,165	1.81
Haskell	92,592	392	265	1,778	95,027	169	1.78	86	28	19	133	154	20,440	[14] 4.65
Latimer	56,427	1,085	6	470	57,988	129	2.22	155		31	186	122	22,665	2.56
LeFlore	348,738	5,006	809	1,278	355,831	1,033	2.90	1,092		220	1,312	104	136,072	2.62
Muskogee	8,638	11,215			19,853	41	2.07	20	53	13	86	60	5,160	[14] 3.85
Okmulgee	214,970	7,069	223	1,737	223,999	426	1.90	514	2	61	577	106	61,032	3.67
Pittsburg	159,890	13,515	1,339	5,350	180,094	483	2.68	433		68	501	157	78,730	2.29
Tulsa	51,093	5,038	5,161	10	61,302	133	2.17	109	30	14	153	113	17,250	3.55
Other counties (Craig, Rogers, and Wagoner)	192,950	9,225	50	2,000	204,225	341	1.67	2	86	24	112	237	26,535	[14] 7.70
Total 1935	1,148,474	60,028	7,878	[1] 13,018	1,229,398	2,879	2.34	2,491	199	461	3,151	122	385,049	3.19
Total 1934	1,138,599	42,738	9,946	[1] 17,006	1,208,289	2,846	2.36	2,518	239	468	3,225	124	399,641	3.02

PENNSYLVANIA (BITUMINOUS)

Allegheny	10,889,601	1,880,964	1,016,513	[16] 69,902	13,856,980	$24,339	$1.76	13,528		1,880	15,408	198	3,049,572	4.54
Armstrong	2,178,271	52,619	57,258	1,104	2,289,252	4,008	1.75	3,409		470	3,879	137	532,585	4.30
Beaver	1,171	72,901	9,525	58	83,655	212	2.53	228		35	263	167	44,042	1.90
Bedford	155,264	85,722	159,015	[16] 6,635	406,636	991	2.44	732		91	823	164	135,029	3.01
Blair	93,405	114,194	3,139	[16] 2,209	212,947	458	2.15	451		89	540	150	80,871	2.63
Butler	519,898	154,136	11,867	1,122	687,023	1,345	1.96	1,152	8	148	1,308	164	213,858	3.21
Cambria	11,013,506	424,836	886,279	[16] 197,145	12,521,766	25,250	2.02	17,343		2,234	19,577	177	3,458,456	3.62
Center	331,338	107,248	7,114	201	445,901	859	1.93	814		101	915	165	150,709	2.96
Clarion	1,094,912	130,370	17,689	2,185	1,245,156	2,047	1.64	1,952	34	213	2,199	175	384,087	3.24
Clearfield	2,794,235	101,315	80,146	4,780	2,980,476	5,506	1.85	5,139	5	611	5,755	161	929,079	3.21
Clinton	2,867	51,424	8,128	230	62,649	127	2.03	104	10	24	138	164	22,573	2.78
Elk	675,930	53,332	7,121	16,770	753,153	1,343	1.78	1,059	9	150	1,218	203	247,821	3.04
Fayette	12,582,451	169,033	122,270	[16] 582,674	13,456,428	27,319	2.03	13,878	163	2,148	16,189	179	2,892,296	4.65
Greene	3,442,414	2,928	23,127	20,298	3,488,767	6,897	1.98	3,539		653	4,192	196	820,553	4.25
Huntingdon	432,596	52,865	3,674	11,222	500,357	1,142	2.28	932		108	1,040	176	182,737	2.74
Indiana	5,258,714	37,493	260,383	[16] 61,944	5,618,534	9,792	1.74	7,000		882	7,882	160	1,258,277	4.47
Jefferson	1,752,240	82,415	4,396	7,894	1,846,945	3,281	1.78	2,572		309	2,881	184	530,899	3.48
Lawrence	141,357	18,558	17,503	1,709	179,127	433	2.42	368		66	434	174	75,478	2.37
Lycoming	10,649	47,413	50	12	58,124	132	2.27	108		15	123	205	25,275	2.30
McKean		14,943	316	116	15,375	31	2.02	26	8	5	39	188	7,322	2.10
Mercer	189,873	111,977	7,859	13,086	322,795	784	2.43	505		97	602	198	119,079	2.71
Somerset	5,466,153	91,568	46,029	96,992	5,700,742	11,394	2.00	7,241	4	1,099	8,344	182	1,519,138	3.75
Tioga	110,625	62,665	4,336	4,543	182,169	550	3.02	469		70	539	161	86,989	2.09
Venango	1,511	10,215		8	11,734	25	2.13	23		5	28	226	6,325	1.86
Washington	14,835,626	251,343	196,887	37,656	15,321,512	27,574	1.80	15,649	135	1,707	17,491	199	3,482,565	4.40
Westmoreland	7,831,354	478,509	285,028	[16] 395,596	8,990,487	15,942	1.77	10,301	23	1,672	11,996	167	1,997,412	4.50
Other counties (Bradford and Fulton)	147,403	18,170		407	165,980	389	2.34	266		40	306	175	53,526	3.10
Total 1935	81,953,364	4,679,156	3,235,652	[16] 1,536,498	91,404,670	172,170	1.88	108,788	399	14,922	[17] 124,109	180	22,306,553	4.10
Total 1934	80,696,259	4,493,554	2,796,698	[16] 1,839,364	89,825,875	165,371	1.84	110,568	260	15,251	126,079	179	22,575,802	3.98

[1] No coal was made into coke at mines in 1934 or 1935.
[5] Revised figures.
[14] The output is chiefly obtained from strip pits, in which the production per man per day is large.
[15] Most of the indicated increase in output per man-day in 1935 was due to strip mining, but there was a slight gain at underground mines also.
[16] Includes coal made into beehive coke at mines in the following counties in 1935: Allegheny, 1,800 tons; Bedford, 5,397; Blair, 1,196; Cambria, 61,908; Fayette, 456,938; Indiana, 41,985; Westmoreland, 308,920. The State total was 878,144 tons in 1935, against 1,136,987 tons in 1934.
[17] The figures of number of men employed in 1935 may not be strictly comparable with those for 1934. The report form in both years asked for "average number of men employed, excluding coke workers and office force", but certain supplementary questions asked in 1935 may have led operators to make more consistent allowance for seasonal fluctuations in employment and for elimination of coke workers and office force. (This would also affect the comparability of the output per man per day.) If at any mine available working time was divided by agreement among the men on rolls, the 1935 returns purport to represent the average number working rather than the total number on the rolls. The 1935 figures have been carefully checked, but it should be noted that the report of the State Department of Mines shows an increase in number employed of 1,478 men over the year 1934.

TABLE 44.—*Production, value, men employed, days operated, man-days of labor, and output per man per day at bituminous-coal mines in specified States and counties in 1935*—Continued

SOUTH DAKOTA (LIGNITE)

County	Net tons					Value		Number of employees				Average number of days mines operated	Man-days of labor	Average tons per man per day
	Loaded at mines for shipment by rail or water	Commercial sales by truck or wagon	Other sales to local trade, or used by employees, or taken by locomotives at tipple	Used for power and heat or made into coke at mines	Total quantity	Total (thousand dollars)	Average per ton	Underground	Surface: In strip pits	Surface: All others	Total			
Meade		1,488	35	35	1,558	$4	$2.57	6		3	9	167	1,500	1.04
Perkins		6,503	20		6,523	9	1.38	8	5	1	14	146	2,050	3.18
Other counties (Corson, Dewey, and Harding)	1,862	3,250	40	10	5,162	8	1.55	7	13	12	32	58	1,840	2.81
Total, 1935	1,862	11,241	95	[1] 45	13,243	21	1.59	21	18	16	55	98	5,390	2.46
Total, 1934	16,785	25,225	347	[1] 50	42,407	76	1.79	21	41	29	91	152	13,812	3.07

TENNESSEE

County	Loaded at mines for shipment by rail or water	Commercial sales by truck or wagon	Other sales to local trade, or used by employees, or taken by locomotives at tipple	Used for power and heat or made into coke at mines	Total quantity	Total (thousand dollars)	Average per ton	Underground	Surface: In strip pits	Surface: All others	Total	Average number of days mines operated	Man-days of labor	Average tons per man per day
Anderson	768,036	4,467	4,108	5,713	782,324	$1,374	$1.76	891		347	1,238	157	194,331	4.03
Bledsoe	23,000	1,400	2,496	100	26,996	54	2.00	61		8	69	154	10,622	2.54
Campbell	968,007	20,321	7,047	4,452	999,827	1,976	1.98	1,639		319	1,958	169	330,928	3.02
Claiborne	688,905	478	11,735	5,442	706,560	1,214	1.72	1,047		133	1,180	175	206,012	3.43
Fentress	309,018		3,764	9,900	322,682	488	1.51	352		77	429	191	81,953	3.94
Hamilton	563	54,958	1,739	30	57,290	97	1.69	140		25	165	147	24,211	2.37
Marion	287,777	22,339	556		310,672	669	2.15	538		124	662	210	139,309	2.23
Morgan	283,955	15,372	743	[18] 7,511	307,581	536	1.74	674		86	760	261	198,432	1.55
Overton		7,562			7,562	12	1.59	22		6	28	125	3,500	2.16
Other counties (northeastern) (Cumberland, Putnam, Roane, and Scott)	54,261	9,900	795	3,068	68,024	111	1.63	118		24	142	178	25,206	2.70
Other counties (southeastern) (Grundy, Rhea, Sequatchie, and White)	502,611	13,681	12,296	[18] 19,696	548,284	904	1.65	810		90	900	164	147,595	3.71
Total, 1935	3,886,133	150,478	45,279	[18] 55,912	4,137,802	7,435	1.80	6,292		1,239	7,531	181	1,362,099	3.04
Total, 1934	3,866,802	156,541	49,038	[18] 63,409	4,135,790	7,514	1.82	5,992		1,316	7,308	185	1,354,595	3.05

TEXAS

Bituminous: Brewster, Palo Pinto, and Webb	23, 859	9, 189	24	2, 899	35, 971	$97	$2. 70	197	-------	69	266	150	39, 956	0. 90
Total bituminous 1935	23, 859	9, 189	24	2, 899	35, 971	97	2. 70	197	-------	69	266	150	39, 956	. 90
Total bituminous 1934	24, 417	4, 058	26	2, 642	31, 143	84	2. 70	191	-------	69	260	166	43, 049	. 72
Lignite:														
Anderson and Henderson	500, 542	534	101	3, 500	504, 677	382	. 76	272	-------	12	284	228	64, 847	7. 78
Bastrop, Bexar, and Milam	157, 458	521	1, 450	-------------	159, 429	97	. 61	130	28	14	172	149	25, 582	6. 23
Harrison, Titus, and Wood	34, 355	21, 764	-----------	1, 333	57, 452	78	1. 36	59	-------	11	70	136	9, 506	6. 04
Total lignite 1935	692, 355	22, 819	1, 551	4, 833	721, 558	557	. 77	461	28	37	526	190	99, 935	7. 22
Total lignite 1934	696, 390	23, 825	75	7, 856	728, 146	1, 061	1. 46	476	35	34	545	184	100, 327	7. 26
State total 1935	716, 214	32, 008	1, 575	[1] 7, 732	757, 529	654	. 86	658	28	106	792	177	139, 891	5. 42
State total 1934	720, 807	27, 883	101	[1] 10, 498	759, 289	1, 145	1. 51	667	35	103	805	178	143, 376	5. 30

UTAH

Carbon	2, 532, 366	71, 273	17, 908	[19] 17, 144	2, 638, 691	$5, 494	$2. 08	1, 888	-------	631	2, 519	187	472, 024	5. 59
Emery	228, 758	22, 208	1, 586	578	253, 130	475	1. 88	122	-------	48	170	194	32, 999	7. 67
Other counties (Grand, Iron, Kane, and Summit)	47, 197	7, 583	317	-------------	55, 097	122	2. 20	53	-------	10	63	191	12, 051	4. 57
Total 1935	2, 808, 321	101, 064	19, 811	[19] 17, 722	2, 946, 918	6, 091	2. 07	2, 063	-------	689	2, 752	188	517, 074	5. 70
Total 1934	2, 293, 892	63, 088	17, 728	[19] 31, 475	2, 406, 183	4, 746	1. 97	2, 115	-------	692	2, 807	171	480, 879	5. 00

VIRGINIA

Buchanan	1, 357, 268	3, 100	300	-------------	1, 360, 668	$2, 067	$1. 52	1, 186	-------	199	1, 385	199	275, 943	4. 93
Dickenson	1, 115, 200	1, 004	12, 069	1, 175	1, 129, 448	1, 880	1. 66	1, 080	-------	182	1, 262	211	266, 703	4. 23
Lee	1, 116, 853	16, 699	13, 720	-------------	1, 147, 272	2, 199	1. 92	1, 424	-------	293	1, 717	194	333, 721	3. 44
Montgomery and Pulaski	179, 291	1, 462	5, 750	-------------	186, 503	430	2. 31	506	-------	118	624	163	101, 501	1. 84
Russell	643, 782	6, 562	9, 487	593	660, 424	1, 140	1. 73	797	-------	186	983	169	166, 476	3. 97
Tazewell	2, 344, 882	37, 211	4, 888	21	2, 387, 002	4, 479	1. 88	2, 729	-------	553	3, 282	186	609, 254	3. 92
Wise	2, 502, 803	13, 767	24, 736	[20] 254, 395	2, 795, 701	4, 933	1. 76	3, 311	-------	479	3, 790	188	713, 805	3. 92
Total 1935	9, 260, 079	79, 805	70, 950	[20] 256, 184	9, 667, 018	17, 128	1. 77	11, 033	-------	2, 010	13, 043	189	2, 467, 403	3. 92
Total 1934	9, 058, 264	78, 530	79, 836	[20] 160, 051	9, 376, 681	16, 375	1. 75	10, 119	-------	2, 088	12, 207	200	2, 443, 569	3. 84

[1] No coal was made into coke at mines in 1934 or 1935.

[18] Includes 424 tons made into coke at mines in Morgan County and 5,623 tons in "Other counties (southeastern)" in 1935, a total of 6,047 tons (compared with a total of 12,502 tons in 1934).

[19] Includes 11,808 tons made into coke at mines in Carbon County in 1935 (25,153 tons in 1934).

[20] Includes 235,498 tons made into coke at mines in Wise County in 1935 (131,275 tons in 1934).

TABLE 44.—*Production, value, men employed, days operated, man-days of labor, and output per man per day at bituminous-coal mines in specified States and counties in 1935*—Continued

WASHINGTON

County	Net tons: Loaded at mines for shipment by rail or water	Net tons: Commercial sales by truck or wagon	Net tons: Other sales to local trade, or used by employees, or taken by locomotives at tipple	Net tons: Used for power and heat or made into coke at mines	Net tons: Total quantity	Value: Total (thousand dollars)	Value: Average per ton	Number of employees: Underground	Number of employees: Surface: In strip pits	Number of employees: Surface: All others	Number of employees: Total	Average number of days mines operated	Man-days of labor	Average tons per man per day
King	343,601	256,527	3,812	578	604,518	$1,813	$3.00	699	-------	197	896	202	181,043	3.34
Kittitas	571,733	36,371	9,765	9,884	627,753	1,814	2.89	573	-------	158	731	215	156,891	4.00
Lewis	22,322	22,571	4,264	-------	49,157	128	2.60	79	-------	18	97	105	10,221	4.81
Pierce	117,314	10,757	2,090	[21] 5,276	135,437	495	3.65	235	-------	92	327	155	50,623	2.68
Other counties (Thurston and Whatcom)	112,333	24,982	1,107	3,919	142,341	436	3.06	169	-------	38	207	166	34,353	4.14
Total 1935	1,167,303	351,208	21,038	[21] 19,657	1,559,206	4,686	3.01	1,755	-------	503	2,258	192	433,131	3.60
Total 1934	1,059,695	288,371	17,967	[21] 16,958	1,382,991	4,002	2.89	1,719	-------	442	2,161	193	417,121	3.32

WEST VIRGINIA

County	Net tons: Loaded at mines for shipment by rail or water	Net tons: Commercial sales by truck or wagon	Net tons: Other sales to local trade, or used by employees, or taken by locomotives at tipple	Net tons: Used for power and heat or made into coke at mines	Net tons: Total quantity	Value: Total (thousand dollars)	Value: Average per ton	Number of employees: Underground	Number of employees: Surface: In strip pits	Number of employees: Surface: All others	Number of employees: Total	Average number of days mines operated	Man-days of labor	Average tons per man per day
Barbour	1,114,802	6,784	3,587	-------	1,125,173	$1,681	$1.49	1,310	-------	168	1,478	138	203,372	5.53
Boone	2,925,397	250	18,385	3,787	2,947,819	4,925	1.67	2,686	-------	479	3,165	192	608,513	4.84
Braxton	12,990	2,662	15,608	-------	31,260	50	1.60	51	-------	11	62	107	6,651	4.70
Brooke	405,509	32,794	623,686	175	1,062,164	1,925	1.81	1,107	-------	144	1,251	181	226,734	4.68
Clay	664,861	-------	19,608	19,343	703,812	1,254	1.78	683	-------	134	817	238	194,704	3.61
Fayette	10,787,499	9,436	247,720	[21] 267,590	11,312,245	21,519	1.90	11,415	-------	1,792	13,207	214	2,831,072	4.00
Gilmer	27,864	2,610	-------	-------	30,474	49	1.61	67	-------	8	75	121	9,080	3.36
Grant	1,076	1,817	-------	-------	2,893	5	1.73	24	-------	4	28	35	986	2.93
Greenbrier	1,550,874	6,241	19,551	9,862	1,586,528	2,878	1.81	1,571	-------	212	1,783	186	331,864	4.78
Hancock	-------	12,216	-------	492	12,708	28	2.20	23	-------	4	27	221	5,980	2.13
Harrison	2,806,604	113,021	13,814	1,285	2,934,724	4,350	1.48	3,141	-------	429	3,570	133	474,344	6.19
Kanawha	5,698,757	25,907	92,929	5,000	5,822,593	9,630	1.65	5,731	-------	843	6,574	196	1,287,206	4.52
Logan	13.295,233	12,701	94,867	13,213	13,416,014	20,770	1.55	10,401	-------	1,898	12,299	184	2,264,942	5.92
McDowell	18,116,403	27.716	216,592	113,385	18.474,096	32,710	1.77	15,711	-------	3,351	19,062	202	3,859,025	4.79
Marion	6,751,756	8,681	48,105	35,918	6,844,460	11,042	1.61	6,211	2	772	6,985	173	1,206,805	5.67

Marshall	552,187	79,856	145,595	10,184	787,822	1,316	1.67	1,000		111	1,111	178	197,462	3.99
Mason	14,252	36,048	4,873	3,600	58,773	86	1.46	122		19	141	114	16,072	3.66
Mercer	3,130,033	7,810	20,810	5,853	3,164,506	5,613	1.77	3,065		783	3,848	196	754,237	4.20
Mineral	276,748	29,522	563	5,767	312,600	585	1.87	492		89	581	202	117,559	2.66
Mingo	3,202,343	51	32,035	360	3,234,789	4,821	1.49	3,038		471	3,509	188	658,736	4.91
Monongalia	4,867,521	39,922	22,519	513	4,930,475	6,684	1.36	4,326		658	4,984	172	859,116	5.74
Nicholas	73,265	4,725	2,271	4,209	84,470	177	2.10	154		37	191	161	30,671	2.75
Ohio	1,775,468	162,296	45,963	102	1,983,829	3,007	1.52	2,068		165	2,233	210	468,753	4.23
Preston	623,910	9,664	38,594	[22] 56,771	728,939	1,155	1.58	1,265		158	1,423	137	194,528	3.75
Putnam	428,077	10,627			438,704	662	1.51	530		79	609	195	118,806	3.69
Raleigh	12,178,531	24,519	114,508	112,519	12,430,077	23,513	1.89	11,783		2,064	13,847	206	2,856,522	4.35
Randolph	446,987	19,672	4,845	10,581	482,085	893	1.85	778		156	934	142	132,520	3.64
Taylor	724,471	19,711	3,945	270	748,397	1,127	1.51	903		89	992	142	140,416	5.33
Tucker	492,757	1,444	7,463	22,168	523,832	1,069	2.04	609		68	677	190	128,633	4.07
Upshur	207,091	8,478	130	6,776	222,475	318	1.43	256		64	320	146	46,721	4.76
Webster	827,648	6,135	20,713	4,868	859,364	1,611	1.87	884		162	1,046	206	214,997	4.00
Wyoming	1,812,209	6,353	12,219	24,333	1,855,114	3,658	1.97	2,023		391	2,414	204	491,456	3.77
Other counties (Lewis, Summers, and Wayne)	16,096	3,453	6,298		25,847	53	2.05	55		17	72	96	6,903	3.74
Total, 1935	95,809,219	733,122	1,897,796	[22] 738,924	99,179,061	169,164	1.71	93,483	2	15,830	109,315	192	20,945,386	4.74
Total, 1934	94,775,558	860,344	1,716,415	[22] 782,076	98,134,393	167,104	1.70	89,457	36	16,413	105,906	196	20,735,272	4.73

WYOMING

Campbell and Crook	99,798	14,736	493	7,907	122,934	$137	$1.11	7	20	10	37	249	9,216	13.34
Carbon	442,171	31,928	3,280	16,687	494,066	1,135	2.30	237	3	84	324	219	70,932	6.97
Converse		11,426		270	11,696	19	1.62	9	5	4	18	189	3,402	3.44
Fremont	23,859	3,138	4,924	4,481	36,402	50	1.37	27		15	42	123	5,152	7.07
Hot Springs	162,303	13,148	2,444	31,206	209,101	551	2.64	196		74	270	250	67,546	3.10
Johnson		7,533	1,746	167	9,446	15	1.59	8		2	10	207	2,072	4.56
Lincoln	433,035	25,476	4,151	11,812	474,474	1,128	2.38	367		109	476	208	98,889	4.80
Sheridan	481,269	37,252	22,387	2,628	543,536	760	1.40	227		67	294	189	55,696	9.76
Sweetwater	3,156,999		25,902	75,910	3,258,811	7,289	2.24	2,004		468	2,472	220	544,687	5.98
Other counties (Big Horn, Park, and Uinta)	8,000	8,576	100		16,676	43	2.58	19		4	23	200	4,594	3.63
Total 1935	4,807,434	153,213	65,427	[1] 151,068	5,177,142	11,127	2.15	3,101	28	837	3,966	217	862,186	[8] 6.00
Total 1934	4,059,131	123,345	52,584	[1] 132,901	4,367,961	9,591	2.20	2,936	25	799	3,760	188	707,603	[8] 6.17

[1] No coal was made into coke at mines in 1934 or 1935.
[8] Much of the output of the State is obtained from strip pits or by the use of loading machines, in which types of operations the production per man is large.
[21] Includes 3,978 tons made into coke at mines in Pierce County in 1935 (2,686 tons in 1934).
[22] Includes 256,617 tons made into coke at mines in Fayette and Preston Counties in 1935 (281,195 tons in 1934).

COAL PRODUCED AND CONSUMED IN ALASKA

TABLE 45.—*Coal produced and consumed in Alaska, 1929–35*

Year	Produced in Alaska, chiefly subbituminous coal and lignite [1]		Imported from States, chiefly bituminous coal from Washington [2] (net tons)	Imported from foreign countries, chiefly bituminous coal from British Columbia [2] (net tons)	Total coal consumed (net tons)
	Net tons	Value			
1929	100,600	$528,000	36,693	27,073	164,366
1930	120,100	631,000	37,128	23,892	181,120
1931	105,900	556,000	30,772	17,796	154,468
1932	102,700	514,000	28,422	12,463	[3] 143,585
1933	96,467	481,000	21,524	14,009	132,000
1934	107,508	451,000	28,317	[3] 13,797	[3] 149,622
1935	119,425	502,000	26,554	15,707	161,686

[1] Compiled by the Alaska Branch of the U. S. Geological Survey.
[2] Compiled from records of the Bureau of Foreign and Domestic Commerce.
[3] Revised figures.

DETAILED STATISTICS OF LIGNITE AND OF ANTHRACITE AND SEMIANTHRACITE OUTSIDE OF PENNSYLVANIA

The summary tables of this report dealing with bituminous coal include for statistical convenience the operations of lignite mines and of mines producing anthracite and semianthracite outside of Pennsylvania.

While these coals constitute a small proportion of the national total, locally they are distinct and important industries. To meet the needs of those concerned, separate figures are given in tables 46 and 47.

For a detailed analysis of the hard-coal industry outside of Pennsylvania see Coal in 1930, pages 721 to 726.

TABLE 46.—*Production, value, men employed, days mines operated, and output per man per day at lignite mines in 1935*

[Includes all coal produced in the areas mapped as "lignite" in U. S. Geol. Survey Prof. Paper 100-A. Note that subbituminous coal, sometimes known as "black lignite", is not included]

	North Dakota	South Dakota	Montana [1]	Texas	Total
Production (net tons):					
Loaded at mines for shipment	1,435,934	1,862	9,000	692,355	2,139,151
Commercial sales by truck or wagon	437,079	11,241	49,544	22,819	520,683
Other sales to local trade or used by employees, etc.	74,329	95	1,243	1,551	77,218
Used at mines for power and heat	8,168	45	81	4,833	13,127
Total production	1,955,510	13,243	59,868	721,558	2,750,179
Value:					
Total	$2,395,000	$21,000	$108,000	$557,000	$3,081,000
Average per ton	$1.22	$1.59	$1.80	$0.77	$1.12
Number of employees:					
Underground	668	21	82	461	1,232
Surface (including strip pits)	697	34	32	65	828
Total employees	1,365	55	114	526	2,060
Average number of days mines operated	188	98	177	190	186
Average tons per man per day	7.61	2.46	2.96	7.22	7.19
Produced by stripping (net tons)	1,136,483	6,578	4,373	91,642	1,239,076

[1] Includes output of Daniels, Dawson, Richland, Roosevelt, Sheridan, Valley, and Wibaux Counties.

TABLE 47.—*Production, value, men employed, days mines operated, and output per man per day at the principal hard-coal mines outside of Pennsylvania in 1935*

[Includes coal classified as anthracite and semianthracite in U. S. Geol. Survey Prof. Paper 100-A, the Coal Fields of the United States]

	Virginia	Arkansas, Colorado, and New Mexico	Total
Production (net tons):			
Loaded at mines for shipment	179,291	231,730	411,021
Commercial sales by truck or wagon	1,462	1,903	3,365
Other sales to local trade or used by employees, or taken by locomotives at tipple	5,750	254	6,004
Used at mines for power and heat		2,700	2,700
Total production	186,503	236,587	423,090
Value:			
Total	$430,000	$823,000	$1,253,000
Average per ton	$2.31	$3.48	$2.96
Number of employees:			
Underground	506	849	1,355
Surface (including strip pits)	118	179	297
Total employees	624	1,028	1,652
Average number of days mines operated	163	117	134
Average tons per man per day	1.84	1.96	1.91

PART 2.—PENNSYLVANIA ANTHRACITE [12]

By F. G. Tryon, H. L. Bennit, and J. R. Bradley

There were a number of important developments in the anthracite industry during 1936. Demand improved, a wage agreement was concluded, and Anthracite Industries, Inc., was organized. The plan to coordinate prices, initiated in 1935, was continued.

Production.—Production of anthracite increased about 5 percent over 1935. According to preliminary figures, the total output of the legitimate operations was 54,760,000 tons, including a relatively small quantity of semianthracite from Sullivan County (see table 1A).

Shipments of all sizes from breakers and washeries in 1936 totaled 46,979,000 tons, an increase of 5.2 percent over 1935. The greater part of the increase of 2,336,000 tons occurred in the last quarter of the year.[13] (See fig. 55.)

[12] Data for 1936 are preliminary; detailed statistics with final revisions will be released later. Data for 1935 are final.

[13] Anthracite Bureau of Information.

The principal statistics for 1935 and 1936 are summarized below:

TABLE 1A.—*Salient statistics of the Pennsylvania anthracite industry, 1935–36*

[Including colliery fuel, dredge and washery coal. All tonnage figures represent net tons of 2,000 pounds]

	1935	1936 [1]	Percent of change in 1936
Production	52, 158, 783	54, 760, 000	+5.0
Value at mines:			
Total	$210, 131, 000	$226, 000, 000	+7.6
Average per ton, all sizes	$4.03	$4.13	+2.5
Average retail price:			
Stove coal, curb delivery [2]	$11.42	$11.73	+2.7
Stocks in yards of producers:			
Jan. 1	1, 921, 000	1, 911, 000	−.5
Dec. 31	1, 911, 000	1, 409, 000	−26.3
Exports	1, 609, 000	1, 678, 000	+4.3
Imports	571, 000	615, 000	+7.7
Consumption (calculated)	51, 100, 000	54, 199, 000	+6.1
Number of men employed [3]	103, 269	102, 300	−.9

[1] Figures for 1936 are in most instances preliminary and subject to revision.
[2] Bureau of Labor Statistics, with allowance for months between the quarterly returns.
[3] Figures for anthracite in 1936 are estimated from the report of the Pennsylvania Department of Mines, with allowance for employees of dredge operators and strip contractors.

The foregoing figures do not include the output of unauthorized mines, exact statistics of which are not obtainable. An estimate of the Anthracite Institute for 1936 is approximately 2,500,000 tons. This tonnage is in addition to the official statistics of production. Thus, the illicit production of and trade in anthracite continued to be a problem. Late in the year the Governor of Pennsylvania announced that a commission would be appointed to investigate and report on the situation.

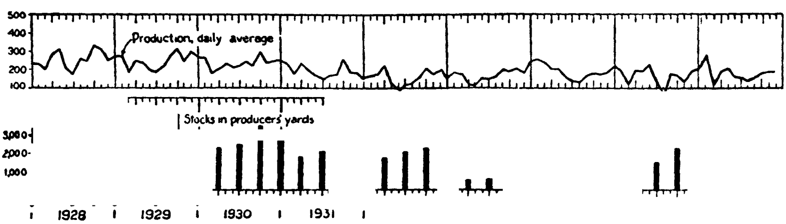


FIGURE 55.—Trends of production and stocks of Pennsylvania anthracite, 1928–36.

Consumption.—Consumption, based on production, plus imports, minus exports, and the change in producers' stocks at the beginning and end of the year was 54,199,000 tons, an increase of 6.1 percent over the 1935 (revised) figure. Sales of unauthorized coal have not been considered in either year.

Distribution.—Loadings at Lake Erie ports amounted to 689,000 tons, an increase of 23.3 percent over 1935. Receipts at Duluth-Superior increased 69.8 percent in comparison with 1935. Shipments off lake docks also increased, in this case 17.2 percent. Tidewater receipts of anthracite in the New England States (including imports)—1,398,000 tons—were approximately the same as in 1935, and receipts by rail were slightly below the 1935 tonnage. Total receipts in New England declined 2.2 percent.

Trend of stocks.—Producers' stocks in the first quarter of 1936 averaged about 300,000 tons a month less than in the corresponding quar-

ter of 1935, were about 150,000 tons a month more during the following 6 months, and in the last quarter were approximately 500,000 tons a month less than in the December quarter of 1935. At the close of the year stocks were 500,000 tons less than in 1935.

Stocks on lake docks in January (220,000 tons) reached the low point in April and the peak in August (444,000 tons) and closed the year at 323,000 tons—10 percent greater than in 1935.

Stocks held by 233 representative dealers totaled to 472,000 tons in January, reached the low point in March at 381,000 tons and the high in July at 679,000 tons, and in December were 593,000 tons, or slightly above the 1935 figure.

Stocks at electric power utilities changed very little during the 12 months and averaged 1,100,000 for the year, a figure almost identical with that for 1935.

The weather.—The mean temperature in the chief anthracite-consuming area in January was about 3° above normal, February 3° below normal, and March 6° to 8° above normal. From September, to November, inclusive, the mean temperature was about 2° below normal and Decmeber 4° to 6° above normal.

The heavy rains and resulting flood in the spring of 1936 forced the closing of certain properties and later entailed heavy expense for pumping. It is probable that while the flood brought downstream unusually large quantities of fine material, dredge operators will find increased difficulty in separating the debris from the coal.

Industry cooperation.—A "coordinator" was appointed for the New York City market, where a fair-trade-practice agreement and open price posting was adopted. The coordinator also endeavors to eliminate the competition of illicit anthracite. Producers and wholesalers, as well as retailers, cooperated in the scheme.

Anthracite Industries, Inc.—In the summer of 1936, Anthracite Industries, Inc., was organized as a cooperative effort by anthracite producers to promote the greater use of anthracite.

Representatives of the organization have been located in 17 of the anthracite-burning areas; their duties include coordinating the efforts of the retailers, the equipment manufacturers, the equipment dealers, and the heating contractors. Demonstrations were held in a number of cities where automatic heating devices using anthracite were displayed.

Prices.—During the first quarter of 1936 the circular price of anthracite stove coal was the same as in the corresponding quarter of 1935, but in the succeeding 5 months was above the 1935 figure, while in the last quarter the price was $0.50 below the 1935 figure. The circular price of buckwheat remained the same as in 1935. (See fig. 56.)

A preliminary estimate, based on returns from companies representing two-thirds of the tonnage, indicates that the average value of all shipments, local sales, and colliery fuel in 1936 was $4.13 per ton compared with $4.03 in 1935. If confirmed by final reports from the companies not yet heard from, this points to a slight increase in average sales realization compared with the year before. The realization, however, was still far below the $5.22 obtained in 1929.

Signs of a slight increase in average realization during 1936 are also found in the prices paid by Canadian buyers for American anthracite. The Canadian Government, for customs purposes, keeps a

record of the fair market value of the coal imported, computed at the point of origin f. o. b. mines. For 1935 and 1936 this record shows the following average prices paid per net ton:

	1935	1936	Change
Prepared sizes, including pea	$6.21	$6.36	+$0.15
Sizes below pea	2.85	3.20	+.35
All sizes	5.82	5.96	+.14

The value at the mines of the anthracite produced in 1936 is estimated at $226,000,000, an increase of 7.6 percent over 1935.

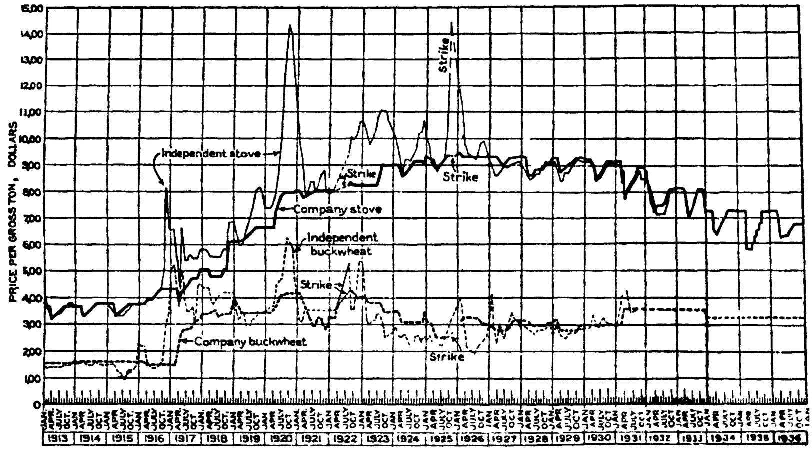


FIGURE 56.—Monthly prices of Pennsylvania anthracite, f. o. b. mine, as quoted by the trade journals, 1913-36. Prices are averages of the range as quoted on the New York market.

TABLE 2A.—*Statistical summary of monthly developments in the Pennsylvania anthracite industry in 1936*

[All tonnage figures represent thousands of net tons]

	1936 [1]													1935 total
	January	February	March	April	May	June	July	August	September	October	November	December	Total	
Production, including mine fuel, local sales, and dredge coal:														
Monthly total	5,333	6,975	3,061	4,773	5,121	4,306	3,925	3,503	3,874	4,608	4,334	4,947	54,760	52,159
Average per working day	205	285	118	191	205	166	151	135	155	177	188	190	180	172
Shipments, breakers and washers only: [2] Monthly total, all sizes	4,865	5,934	2,429	4,217	4,274	3,516	3,345	2,917	3,440	3,942	3,783	4,317	46,979	44,643
Distribution:														
Lake loadings	-------	-------	44	57	114	104	131	138	54	29	18	(3)	689	559
Receipts at Duluth-Superior	-------	-------	-------	-------	110	24	63	63	36	13	-------	-------	309	182
Shipments from lake docks	73	99	17	17	31	91	31	42	49	73	55	55	633	540
New England receipts:														
By tide (including imports)	161	89	107	125	163	102	125	114	86	112	116	98	1,398	1,374
By rail	381	472	209	246	400	300	266	234	294	351	361	375	3,889	4,030
Exports	158	210	89	112	212	112	102	108	135	155	141	144	1,678	1,609
Imports	82	56	44	46	37	38	47	82	46	38	54	45	615	571
Industrial consumption by:														
Railroads (class I only)	159	155	136	120	117	116	152	108	106	127	137	153	1,586	1,470
Electric-power utilities	169	172	126	148	153	153	171	182	175	172	162	169	1,952	1,792
Stocks at end of period shown:														
Railroads (class I only)	204	232	202	194	250	255	294	292	308	344	334	320	320	198
Electric-power utilities	1,088	1,075	996	1,034	1,057	1,099	1,336	1,101	1,099	1,114	1,089	1,100	1,100	1,107
Stocks on lake docks	220	127	109	102	257	277	364	444	443	403	378	323	323	293
Retail stocks, 233 representative dealers	472	442	381	432	618	634	679	678	654	647	642	593	593	571
Producers' stocks [2]	1,217	528	458	369	853	1,240	1,556	1,992	2,347	1,771	1,732	1,409	1,409	1,911
Prices at mines, average per net ton: [4]														
Company stove	$7.25	$7.25	$7.25	$6.25	$6.35	$6.35	$6.45	$6.55	$6.75	$6.75	$6.75	$6.75	$6.73	$6.71
Company buckwheat no. 1	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25
Average price paid by Canadian buyers, f. o. b. American mines: [5]														
Prepared sizes, including pea	$6.73	$6.76	$6.81	$6.28	$5.96	$5.83	$6.03	$6.14	$6.24	$6.35	$6.37	$6.43	$6.33	$6.18
Retail prices (average 25 cities): [6]														
Stove	$12.07	(7)	(7)	$11.80	(7)	(7)	$11.36	(7)	$11.68	(7)	(7)	$11.80	$11.73	$11.42
Chestnut	$11.76	(7)	(7)	$11.61	(7)	(7)	$11.20	(7)	$11.62	(7)	(7)	$11.81	$11.58	$11.16
Wholesale prices, index numbers (1926=100)	82.3	82.6	82.5	80.0	76.6	77.0	78.5	79.1	80.6	81.8	82.4	82.3	80.5	79.7
Labor conditions: [8]														
Index of employment (1929 average=100)	59.1	61.2	52.5	49.8	54.9	51.2	48.4	41.1	47.6	49.9	51.5	54.8	51.8	53.2
Index of pay-roll totals (1929 average=100)	54.4	76.7	42.6	28.6	56.3	42.0	37.2	31.4	34.9	48.5	40.3	55.4	45.7	47.5

[1] Subject to revision.
[2] As reported by the Anthracite Institute.
[3] Less than 500 tons.
[4] Quoted by trade journals in New York market.
[5] Computed from Quarterly Trade Returns of Canada.
[6] Bureau of Labor Statistics, curb delivery.
[7] No data.
[8] Bureau of Labor Statistics index numbers.

Exports.—Anthracite exports in 1936 were 4.31 percent greater than in 1935. Of the 1936 exports 71.6 percent was cleared through the Buffalo customs district. Canada took 99.0 percent in 1935 and 99.2 percent in 1936. Imports of anthracite into the United States in 1936 were 36.7 percent of exports.[14]

Changing sources of supply characterized the market for anthracite in Canada.

Imports of anthracite into Canada in 1934, 1935, and 1936 were 3,537,000, 3,451,000, and 3,561,000 tons, respectively. In 1934, 1935, and 1936 the United States supplied 51.0 percent, 48.4, and 47.3 percent, respectively; Great Britain, 46.5 percent, 42.1, and 36.8 percent, respectively; Germany, 2.0, 5.9, and 10.6 percent; French Indochina, nil, 1.6, and 3.5 percent; Belgium, 0.5, 2.0, and 1.3 percent; and the Netherlands, nil, nil, and 0.4 percent, respectively.

The estimated displacement of coal by natural gas used for domestic purposes in Canada in 1935 was 640,000 tons, the highest figure since 1931, when the amount was 680,000 tons. Fuel oil for domestic use and building heating also gained, the amount representing 784,000 tons of coal in 1934 as against 693,571 tons in 1933.[15]

Imports.—Imports of foreign anthracite into the United States increased 7.7 percent over 1935. Nearly three-fourths of the total originated in Russia and practically all of the remainder in Great Britain. As usual, nearly all of the imports entered the New England States.

Imports of coke into New England States and New York increased from 198,041 tons in 1935 to 203,127 in 1936. Coke imports from Belgium ranked first and were two and one-half times greater than the previous year; the Canadian figures did not differ greatly, but a decrease took place in receipts from Germany and Great Britain. About 36 percent of the imports entered the New York customs districts and 22 percent the Massachusetts, 19 percent the Los Angeles and San Francisco, and 9 percent the Buffalo district.

Imports of fuel briquets amounted to 20,350 tons, an increase of 21 percent over the 1935 figure. All were imported from Belgium and entered the Massachusetts customs district.

Freight rates.—The motor-compelled rates applicable to anthracite handled by rail, which became effective in 1935, were maintained during the year.

Competitive fuels.—A further increase in the use of competitive fuels for domestic consumption is indicated for 1936. The statistical trend of the competition of other fuels with anthracite may be found in the chapter on Coke and Byproducts. (See p. 920.)

Range- and heating-oil sales continued to show increases. Sales of range oil amounted to 21,526,000 barrels in 1935 compared with 15,756,000 in 1934; the New England States, New York, and New Jersey took 16,952,000 barrels, an increase of 3,380,000 over 1934. Sales of heating oils proper, for domestic and commercial purposes, totaled 76,853,000 barrels in 1935, an increase of 26.3 percent over 1934. The 1934 figure was an increase of 21.3 percent over 1933. In 1935, for the first time, oils used for heating exceeded those used for the bunkering of vessels.

---

[14] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

[15] Coal Statistics for Canada, 1934 and 1935, p. 8.

Sales of natural gas to domestic consumers, which includes gas used for house heating, increased 8.3 percent over 1935, according to the American Gas Association. Sales in 1936 in New York were 4.3 percent and in Pennsylvania 9.2 percent more than in 1935.

Sales of manufactured gas for domestic cooking, water heating, and gas lighting decreased slightly in comparison with 1935. Sales for house heating, however, again showed a noteworthy increase—21 percent over 1935.

Sales of liquefied petroleum gases increased sharply, jumping from 509,000 barrels in 1935 to 714,619 in 1936, or 40.4 percent. Sales in 1935 were 21 percent over the 1934 figure.

The use of byproduct coke for domestic purposes amounted to 9,643,507 tons in 1936 compared with 9,161,980 in 1935, and sales of beehive coke sold for domestic purposes totaled 377,836 tons as against 264,406 in 1935.

The production of fuel briquets totaled 1,124,973 tons—30.7 percent more than in 1935. In 1936 briquets manufactured in the Eastern States comprised 31.2 percent of the national production compared with 35.9 percent in 1935. The average value per ton in the Eastern States continued to decline, having been \$4.72 in 1934, \$4.48 in 1935, and \$4.19 in 1936. Packaged-fuel data are not included in the foregoing. Imports of briquets in 1935 and 1936 were 16,778 and 20,350 tons, respectively. The production of petroleum coke declined from 1,458,000 tons in 1935 to 1,378,000 in 1936, or by 5.5 percent.

Sales of both mechanical stokers and oil burners again increased. Sales of mechanical stokers for residences and apartment houses in 1936 totaled 80,924, an increase of 82.7 percent over 1935. Sales in 1935 were 73.7 percent over 1934. Shipments of domestic oil burners in 1936 numbered 157,413 (41.9 percent over 1935), which was about 43 percent over the 1934 figure.

Wage agreement.—A new wage agreement between anthracite mine operators and the United Mine Workers of America was consummated early in the year and approved by the Tri-District Convention in June 1936. The agreement, which expires April 30, 1938, mainly provides for a 7-hour day and a 5-day week from May 1, 1937, at the same daily wage rate as was previously paid for 8 hours, and the complete check-off of union dues by the operators. A clause also provides for full responsibility on the part of district and international officers of the United Mine Workers of America to prevent strikes in violation of the agreement.

Employment.—The number of men employed at the anthracite mines declined from 103,269 in 1935 to 102,300 in 1936, or about 1 percent, according to the Pennsylvania Department of Mines, with allowance for employees of dredge operators and strip contractors. Employment in 1935 was 5.4 percent less than in 1934. The number of men on strike in 1935 was the lowest since 1930.

Mechanical loading.—All the related facts of deep-mined production, tons mechanically loaded, and purchases of new equipment indicate the continuing importance of mechanized loading in the anthracite field.

Tables 17A to 20A, inclusive, show the coal mechanically loaded through 1935. In 1935, 9,279,057 tons were handled compared with 9,284,486 tons in 1934, a slight decline of 5,429 tons. In connection

with this small drop note that the total production of deep-mined anthracite was 43,679,000 tons in 1935 and 48,574,000 tons in 1934. A further advance in the degree of mechanized loading is therefore recorded for 1935 in that 21.2 percent of the deep-mined output was mechanically handled compared with 19.1 percent in 1934.

Preliminary reports to the Pennsylvania Department of Mines indicate a total of 11,019,235 tons of anthracite loaded mechanically in 1936, and it is known that large purchases of new equipment were made during the year.[16] In 1935, mine operators reported 1,593 conveyors in use, including hand-loaded types as well as those equipped with duckbills or other self-loading heads. In 1936, 28 manufacturers of equipment reported that 312 new units were sold, which compares with 354 units sold by the same manufacturers in 1935. It is not possible to segregate these sales as to whether they were for replacement of worn-out or obsolete machinery, or for entirely new installations to replace hand loading.

FINAL STATISTICS OF ANTHRACITE IN 1935

SOURCES AND ACKNOWLEDGMENTS

Tables 3A to 27A present the final detailed statistics of operations in the anthracite industry in 1935. The principal data were issued in the mimeographed report Pennsylvania Anthracite Coal Tables, 1935, released January 16, 1937, and the detailed record is preserved for permanent reference in this volume.

The statistics are based upon reports courteously furnished by mine operators under the system of voluntary cooperation used in all statistical services of the Bureau of Mines.

The Bureau's standard inquiries relate to production, value of product, employment, and mechanical equipment of the mines. In 1935, certain supplementary questions were asked regarding cost of materials, fuel and power, wages paid, and number and total compensation of salaried employees. These additional items were requested for 1 year only and were added to avoid what would otherwise have been serious duplication of statistical questionnaires. A general Census of Business had been undertaken for the year 1935, designed to cover all branches of American industry and trade. At the suggestion of the Central Statistical Board, it was arranged that these supplementary inquiries regarding anthracite should be carried on the Bureau of Mines annual return. The Bureau was responsible for their collection and tabulation, and throughout the records remained in the confidential custody of its sworn employees. The results have been published in multigraphed form by the Bureau of the Census, and a detailed report has been issued under the title, "Employment and Related Statistics of Mines and Quarries, 1935, Part II—Pennsylvania Anthracite." [17]

To all operators responding to the unusually heavy requests for information in 1935, cordial thanks are extended.

The tables in the present chapter are confined to the standard items covered in previous reports of the Bureau of Mines.

---

[16] Plein, L. N., and Tryon, F. G., Sales of Mechanical Loading and Cleaning Equipment for Use in Coal Mines in 1936: Min. Cong. Jour., February 1937, pp. 57-60. See also the chapter on Progress in Mine Mechanization.

[17] Tryon, F. G., Otero, M., and Ashmead, D. C., Employment and Related Statistics of Mines and Quarries, Part II—Pennsylvania Anthracite· Works Progress Administration National Research Project on Reemployment Opportunities and Recent Changes in Industrial Technique, Report E-4.

FIELDS AND OPERATIONS INCLUDED

The Pennsylvania anthracite industry.—Trade practice and historical usage recognize two major divisions in the coal industry of the United States—bituminous coal and Pennsylvania anthracite. Anthracite and semianthracite are mined in parts of Virginia, Arkansas, Colorado, and New Mexico. Locally these coals represent distinct and important industries; but the tonnages involved are small, and for statistical convenience they are usually grouped with the totals of the bituminous coal industry, and they have been so grouped in this report. Separate figures, however, are given in table 47.

The Pennsylvania anthracite industry, as here defined, includes all the nonbituminous fields of that State. Trade usage commonly includes with Pennsylvania anthracite the output of the Bernice Basin in Sullivan County, although the coal of this basin is officially classified as semianthracite, according to the tentative standard of coal classification adopted by the American Society for Testing Materials.

Districts and fields.—The main anthracite region is divided into three subregions or districts—Lehigh, Schuylkill, and Wyoming. This is the areal grouping most commonly used in trade statistics, and it is followed also in the district organization of the United Mine Workers of America, in which district 1 corresponds to the Wyoming trade region, district 7 to the Lehigh region, and district 9 to the Schuylkill region. The district grouping, therefore, is used in the primary tables of this report. For technical operating studies, however, a grouping into four fields—Northern, Western Middle, Eastern Middle, and Southern—is preferred because it follows more closely the geologic conditions which largely influence the methods and costs of mining. The field grouping is followed in tables 7A and 9A. The Northern field is coterminous with the Wyoming district. That part of the Southern field lying east of Tamaqua, known as the Panther Creek Valley, and the Eastern Middle field make up the Lehigh district. That part of the Southern field west of Tamaqua and the Western Middle field comprise the Schuylkill district.

Small mines and intercompany sales.—No attempt was made to cover the production of illicit or bootleg coal, the quantity of which produced in 1935 has been variously estimated at approximately 4,000,000 tons. All known legitimate operations are included in the statistics. In recent years, conditions have favored the development of numerous small mines operating on lease or subcontract and producing run-of-mine coal, which is sold to larger companies for preparation at a breaker. At the same time there has developed an increasing transfer of coal from one operation to another, and one of the largest companies has built great central breakers to which coal from numerous collieries is shipped by rail for preparation. These tendencies have increased the complexity of the task of compilation, but great care has been exercised to avoid double counting of the tonnage produced by one operator and prepared for market by another, so that the figures are believed to represent the net quantity of merchantable coal plus the fuel used by the collieries themselves. At the same time, the employees of operators producing run-of-mine only have been included, since they have received wages from the industry and have contributed to the final product.

Reports from stripping contractors.—On account of the great increase in the quantity of coal mined by stripping, the Bureau of Mines has for some years made special arrangements to record the employees of strip contractors. A special report is obtained from all known strip contractors of the number of men employed and days worked during the year. In 1935 it was found that an average of 3,053 men was employed by the strip contractors. These men are properly to be counted in the working force of the industry and are included in the tables of this report. Care is taken, however, to avoid double counting of production between the contractor and the colliery company for which the work is done.

STATISTICAL SUMMARY

TABLE 3A.—*Statistical trends of the Pennsylvania anthracite industry, 1931–35*

	1931	1932	1933	1934	1935
Production:					
Loaded at mines for shipment:					
Breakers.....net tons..	[1] 51, 264, 291	[1] 42, 994, 291	41, 780, 739	49, 435, 764	44, 369, 285
Washeries.....do....	1, 295, 190	648, 086	1, 231, 984	966, 804	1, 794, 402
Dredges.....do....	199, 268	252, 346	322, 686	353, 754	374, 142
Sold to local trade and used by employees.....net tons..	2, 901, 117	2, 810, 337	3, 249, 552	3, 285, 936	2, 874, 970
Used at collieries for power and heat net tons..	3, 985, 786	3, 150, 161	2, 956, 383	3, 126, 033	2, 745, 984
Total production.....do....	59, 645, 652	49, 855, 221	49, 541, 344	57, 168, 291	52, 158, 783
Value at breaker, washery, or dredge.......	$296,355,000	$222,375,000	$206,718,000	$244,152,000	$210,131,000
Average sales realization per net ton on breaker shipments:					
Lump and broken.....	$6.74	$5.69	$5.43	$5.43	$5.16
Egg.....	$7.01	$6.17	$5.90	$5.88	$5.44
Stove.....	$7.37	$6.53	$6.25	$6.23	$5.87
Chestnut.....	$7.21	$6.26	$5.95	$5.98	$5.64
Pea.....	$4.76	$4.55	$4.22	$4.40	$4.16
Total domestic.....	$6.87	$6.09	$5.78	$5.80	$5.45
Buckwheat No. 1.....	$2.79	$2.83	$2.84	$2.86	$2.88
Buckwheat No. 2 (rice).....	$1.52	$1.52	$1.50	$1.56	$1.74
Buckwheat No. 3 (barley).....	$1.03	$0.97	$1.00	$0.97	$1.08
Boiler.....	$0.29	$0.81	$1.24	$1.25	------------
Other, including Buckwheat No. 4....	$0.57	$0.55	$0.63	$0.71	$0.57
Total steam.....	$2.00	$1.98	$1.93	$1.98	$2.03
Total, all sizes.....	$5.35	$4.74	$4.46	$4.53	$4.29
Percentage by sizes in total breaker shipments:					
Lump and broken.....percent..	0.3	0.3	0.4	0.3	0.3
Egg.....do....	9.6	9.1	8.5	7.9	7.0
Stove.....do....	23.6	23.7	22.8	22.4	21.8
Chestnut.....do....	25.0	24.3	24.0	25.5	26.1
Pea.....do....	10.3	9.9	10.2	10.6	10.7
Total domestic.....do....	68.8	67.3	65.9	66.7	65.9
Buckwheat No. 1.....do....	14.9	15.5	15.2	15.3	15.1
Buckwheat No. 2 (rice).....do....	8.6	8.6	8.9	8.6	9.3
Buckwheat No. 3 (barley).....do....	6.7	7.2	7.8	7.6	7.8
Boiler.....do....	0.2	0.2	0.1	(2)	------------
Other, including Buckwheat No. 4 percent..	0.8	1.2	2.1	1.8	1.9
Total steam.....do....	31.2	32.7	34.1	33.3	34.1
Producers' stocks on Dec. 31 [3].....net tons..	3, 073, 000	1, 732, 000	1, 106, 000	1, 921, 000	1, 911, 000
Exports.....do....	1, 778, 000	1, 303, 000	1, 035, 000	1, 298, 000	1, 609, 000
Imports.....do....	638, 000	607, 000	456, 000	478, 000	571, 000
Consumption (calculated).....do....	58, 408, 000	50, 500, 000	49, 600, 000	55, 500, 000	51, 100, 000
Capacity in operation (calculated)...do....	100, 000, 000	94, 000, 000	83, 000, 000	84, 000, 000	84, 000, 000
Average number of days worked.....	181	162	182	207	189
Man days lost on account of strikes and lock-outs.....	570, 664	289, 523	686, 692	774, 856	763, 307
Number of men on strike during year.....	65, 907	34, 259	50, 948	38, 994	26, 127
Average number of men employed.....	139, 431	121, 243	104, 633	109, 050	103, 269
Output per man per day.....net tons..	2.37	2.54	2.60	2.53	2.68
Output per man per year.....do....	428	411	473	524	505
Quantity cut by machines.....do....	1, 587, 265	1, 674, 223	1, 648, 249	1, 981, 088	1, 848, 095
Quantity mined by stripping.....do....	3, 813, 237	3, 980, 973	4, 932, 069	5, 798, 138	5, 187, 072

[1] Includes 122,894 tons of coal stored at collieries in 1931 and 33,060 tons in 1932.
[2] Less than 0.1 percent.
[3] From records of the Anthracite Institute. Figures represent prepared coal on the ground at the breaker.

TABLE 3A.—*Statistical trends of the Pennsylvania anthracite industry, 1931–35*—Continued

	1931	1932	1933	1934	1935
Quantity loaded by machines under ground....net tons..	4,384,780	5,433,340	6,557,267	9,284,486	9,279,057
Distribution:					
Total receipts in New England[4] net tons..	7,064,000	5,639,000	5,252,000	5,992,000	5,404,000
Exports to Canada....do....	1,772,000	1,301,000	1,027,000	1,266,000	1,592,000
Loaded into vessels at Lake Erie[5] net tons..	761,000	294,000	425,000	607,000	559,000
Receipts at Duluth Superior[6]...do....	300,000	66,000	135,000	229,000	182,000

[4] From records of the Massachusetts Department of Labor and Industries, divison on the necessaries o life.
[5] From records of the Ore and Coal Exchange.
[6] From records of the United States Engineer Office, Duluth, Minn.

PRODUCTION, BY WEEKS AND MONTHS

The following tables summarize the statistics of weekly and monthly production of anthracite first published in the Bureau of Mines' weekly coal reports. Statistics of current output are estimated from records of cars of anthracite loaded by the nine railroads that serve the region, checked in turn against tonnage reports from trade sources. The weekly and monthly figures, as given in tables 4A and 5A, have been adjusted to the annual total ascertained by direct canvass of the operators themselves.

TABLE 4A.—*Estimated weekly production of Pennsylvania anthracite in 1935, in net tons*

Week ended	Weekly production	Number of working days	Daily average	Week ended	Weekly production	Number of working days	Daily average
Jan. 5	[1] 931,000	[1] 4	[2] 234,200	July 20	803,000	6	133,800
Jan. 12	1,231,000	6	205,200	July 27	881,000	6	146,800
Jan. 19	1,247,000	6	207,800	Aug. 3	950,000	6	158,300
Jan. 26	1,369,000	6	228,200	Aug. 10	473,000	6	78,800
Feb. 2	1,515,000	6	252,500	Aug. 17	481,000	6	80,200
Feb. 9	1,371,000	6	228,500	Aug. 24	456,000	6	76,000
Feb. 16	1,228,000	6	204,700	Aug. 31	1,198,000	6	199,700
Feb. 23	875,000	5.5	159,100	Sept. 7	564,000	5	112,800
Mar. 2	1,012,000	6	168,700	Sept. 14	814,000	6	135,700
Mar. 9	755,000	6	125,800	Sept. 21	1,009,000	6	168,200
Mar. 16	712,000	6	118,700	Sept. 28	1,563,000	6	260,500
Mar. 23	764,000	6	127,300	Oct. 5	953,000	6	158,800
Mar. 30	660,000	6	110,000	Oct. 12	1,125,000	6	187,500
Apr. 6	687,000	5	137,400	Oct. 19	1,037,000	6	172,800
April 13	1,267,000	6	211,200	Oct. 26	793,000	6	132,200
April 20	1,324,000	6	220,700	Nov. 2	635,000	5	127,000
Apr. 27	1,160,000	6	193,300	Nov. 9	554,000	6	92,300
May 4	961,000	6	160,200	Nov. 16	612,000	5	122,400
May 11	975,000	6	162,500	Nov. 23	1,028,000	6	171,300
May 18	1,173,000	6	195,500	Nov. 30	990,000	5	198,000
May 25	1,334,000	6	222,300	Dec. 7	1,173,000	6	195,500
June 1	1,249,000	5	249,800	Dec. 14	1,140,000	6	190,000
June 8	1,385,000	6	230,800	Dec. 21	891,000	6	148,500
June 15	1,457,000	6	242,800	Dec. 28	883,000	5	176,600
June 22	1,140,000	6	190,000	Jan. 4, 1936	[1] 545,000	[1] 2	[2] 240,400
June 29	1,493,000	6	248,800				
July 6	689,000	5	137,800	Total	52,159,000	303.5	171,900
July 13	644,000	6	107,300				

[1] Figures represent the output of working days in that part of the week included in the calendar year 1935. Figures of total production for the week of Jan. 5, 1935 are 1,108,000 tons, and for Jan. 4, 1936, 1,202,000 tons.
[2] Average daily production for the entire week and not for the working days that fell in the calendar year 1935.

TABLE 5A.—*Estimated monthly production of Pennsylvania anthracite, 1932–35* [1]

[Production figures represent thousands of net tons]

Month	1932			1933			1934			1935		
	Monthly production	Number of working days	Daily average	Monthly production	Number of working days	Daily average	Monthly production	Number of working days	Daily average	Monthly production	Number of working days	Daily average
January	3,937	25	157	3,818	25	153	6,102	26	231	5,790	26	223
February	4,061	24.5	166	4,287	23.5	182	5,930	23.5	252	4,652	23.5	198
March	4,838	27	179	4,532	27	168	6,394	27	237	3,228	26	124
April	5,686	25	227	2,899	24	121	4,819	24	201	4,763	25	191
May	3,311	25	132	2,975	26	114	5,230	26	201	5,118	26	197
June	2,576	26	99	3,939	26	152	4,168	26	160	5,724	25	229
July	3,052	25	122	3,688	25	148	3,430	25	137	3,502	26	135
August	3,500	27	130	4,409	27	163	3,570	27	132	3,073	27	114
September	4,151	25	166	5,007	25	200	3,962	24	165	4,113	24	171
October	5,287	25	212	4,725	25	189	4,711	26	181	4,132	26	159
November	4,315	24	180	4,825	24	201	4,165	24	174	3,432	24	143
December	5,141	26	198	4,437	25	178	4,687	25	187	4,632	25	185
Total	49,855	304.5	164	49,541	302.5	164	57,168	303.5	188	52,159	303.5	172

[1] Production is estimated from weekly car loadings as reported by the Association of American Railroads and includes mine fuel, coal sold locally, and dredge coal. Does not include an unknown amount of "bootleg" production. In computing the average rates per working day, New Year's, Eight-Hour Day (Apr. 1), Memorial Day, Independence Day, Labor Day, Mitchell Day (Oct. 29), Thanksgiving Day, Christmas, and, since the war, Armistice Day, have been counted as holidays. Beginning with 1927, Washington's Birthday is counted as a half holiday. No allowance, however, has been made for church holy days, which are observed by many of the miners. Monthly statistics from 1905 to 1925 will be found in Coal in 1925, pp. 427–428, and from 1926 to 1930 in Coal in 1930, p. 741.

PRODUCTION, BY REGIONS

TABLE 6A.—*Pennsylvania anthracite shipped, sold locally, and used as colliery fuel in 1935, by districts*

District	Shipments		Local sales		Colliery fuel		Total	
	Net tons	Value [1]	Net tons	Value	Net tons	Value	Net tons	Value [1]
Anthracite region, excluding Sullivan County								
Lehigh:								
Breaker product	6,939,191	$29,202,045	298,972	$1,374,608	417,423	$669,276	7,655,586	$31,245,929
Dredge product	78,578	90,224					78,578	90,224
Total Lehigh	7,017,769	29,292,269	298,972	1,374,608	417,423	669,276	7,734,164	31,336,153
Schuylkill:								
Breaker product	12,779,324	50,823,898	601,978	2,517,938	534,259	767,541	13,915,561	54,109,377
Washery product	1,514,648	3,528,918	49,908	152,674	17,671	28,980	1,582,227	3,710,572
Dredge product	295,564	188,397	194,560	203,693	2,538	2,197	492,662	394,287
Total Schuylkill	14,589,536	54,541,213	846,446	2,874,305	554,468	798,718	15,990,450	58,214,236
Wyoming:								
Breaker product	24,547,692	109,796,251	1,635,014	7,457,658	1,517,529	1,691,758	27,700,235	118,945,667
Washery product	279,754	672,572	1,160	3,548	243,828	323,138	524,742	999,258
Dredge product			19,227	32,793			19,227	32,793
Total Wyoming	24,827,446	110,468,823	1,655,401	7,493,999	1,761,357	2,014,896	28,244,204	119,977,718
Total, excluding Sullivan County:								
Breaker product	44,266,207	189,822,194	2,535,964	11,350,204	2,469,211	3,128,575	49,271,382	204,300,973
Washery product	1,794,402	4,201,490	51,068	156,222	261,499	352,118	2,106,969	4,709,830
Dredge product	374,142	278,621	213,787	236,486	2,538	2,197	590,467	517,304
Total	46,434,751	194,302,305	2,800,819	11,742,912	2,733,248	3,482,890	51,968,818	209,528,107
Sullivan County: [2]								
Breaker product	103,078	300,325	74,151	289,115	12,736	13,018	189,965	602,458
Grand total	46,537,829	194,602,630	2,874,970	12,032,027	2,745,984	3,495,908	52,158,783	210,130,565

[1] Value given is value at which coal left possession of producing company f. o. b. mines and does not include margins of separately incorporated sales companies.

[2] For purposes of historical comparison and statistical convenience the mines of Sullivan County are grouped with the Pennsylvania anthracite region although the product is classified as semianthracite according to the American Society for Testing Materials Tentative Standard.

PRODUCTION, BY FIELDS AND COUNTIES

TABLE 7A.—*Pennsylvania anthracite produced, by fields, 1931–35, in net tons*

[The figures of breaker product include a certain quantity of culm-bank coal, which in 1935 amounted to 617,000 tons. Data for 1913–25 will be found in Coal in 1925, p. 517, and for 1926–30 in Coal in 1930, p. 747]

	1931	1932	1933	1934	1935
Anthracite region, excluding Sullivan County					
Eastern Middle:					
Breakers	[1] 6, 075, 000	5, 417, 755	5, 536, 113	6, 013, 462	5, 248, 176
Washeries	(1)	-----------	8, 096	-----------	-----------
Total	6, 075, 000	5, 417, 755	5, 544, 209	6, 013, 462	5, 248, 176
Western Middle:					
Breakers	11, 912, 000	9, 153, 447	9, 450, 345	12, 417, 648	10, 231, 664
Washeries	916, 000	441, 243	830, 361	801, 391	1, 483, 023
Dredges	161, 000	190, 067	233, 210	213, 567	231, 711
Total	12, 989, 000	9, 784, 757	10, 513, 916	13, 432, 606	11, 946, 398
Southern:					
Breakers	7, 883, 000	7, 001, 313	6, 274, 248	7, 384, 649	6, 091, 307
Washeries	65, 000	29, 010	77, 776	82, 910	99, 204
Dredges	298, 000	279, 948	287, 724	409, 448	339, 529
Total	8, 246, 000	7, 310, 271	6, 639, 748	7, 877, 007	6, 530, 040
Northern:					
Breakers	31, 876, 000	26, 938, 993	26, 109, 575	29, 322, 571	27, 700, 235
Washeries	403, 000	305, 625	602, 525	302, 540	524, 742
Dredges	-----------	10, 035	17, 990	29, 165	19, 227
Total	32, 279, 000	27, 254, 653	26, 730, 090	29, 654, 276	28, 244, 204
Total, excluding Sullivan County:					
Breakers	57, 746, 000	48, 511, 508	47, 370, 281	55, 138, 330	49, 271, 382
Washeries	1, 384, 000	775, 878	1, 518, 758	1, 186, 841	2, 106, 969
Dredges	459, 000	480, 050	538, 924	652, 180	590, 467
Total	59, 589, 000	49, 767, 436	49, 427, 963	56, 977, 351	51, 968, 818
Sullivan County: Breakers	57, 000	87, 785	113, 381	190, 940	189, 965
Grand total	59, 646, 000	49, 855, 221	49, 541, 344	57, 168, 291	52, 158, 783

[1] A small amount of washery product is included with the breaker product.

TABLE 8A.—*Pennsylvania anthracite produced in 1935, by counties*

County	Shipments		Local sales	
	Net tons	Value [1]	Net tons	Value
Carbon	1, 441, 092	$5, 546, 253	57, 966	$273, 689
Columbia	185, 913	849, 933	23, 533	32, 447
Dauphin	487, 581	1, 921, 407	150, 318	168, 567
Lackawanna	9, 494, 268	41, 563, 615	772, 613	3, 735, 496
Luzerne	18, 716, 042	83, 871, 709	1, 035, 625	4, 438, 214
Northumberland	5, 287, 474	18, 844, 788	269, 760	997, 924
Schuylkill	10, 253, 386	39, 573, 027	470, 812	2, 040, 392
Sullivan	103, 078	300, 325	74, 151	289, 115
Susquehanna and Wayne	470, 745	2, 024, 351	6, 854	38, 132
Berks, Lebanon, Lehigh, and Northampton [2]	98, 250	107, 222	13, 338	18, 051
Total, 1935	46, 537, 829	194, 602, 630	2, 874, 970	12, 032, 027
Total, 1934	50, 756, 822	226, 258, 289	3, 285, 936	13, 755, 860
Change, 1935 ......percent	−8. 3	−14. 0	−12. 5	−12. 5

TABLE 8A.—*Pennsylvania anthracite produced in 1935, by counties*—Continued

County	Colliery fuel		Total		Men employed
	Net tons	Value	Net tons	Value [1]	
Carbon	37,255	$105,791	1,536,313	$5,925,733	3,779
Columbia	12,087	15,446	221,533	897,826	738
Dauphin	4,250	5,713	642,149	2,095,687	1,230
Lackawanna	548,842	696,379	10,815,723	45,995,490	21,403
Luzerne	1,480,326	1,687,534	21,231,993	89,997,457	45,586
Northumberland	77,105	116,305	5,634,339	19,959,017	8,009
Schuylkill	534,761	802,253	11,258,959	42,415,672	20,992
Sullivan	12,736	13,018	189,965	602,458	524
Susquehanna and Wayne	38,622	53,469	516,221	2,115,952	965
Berks, Lebanon, Lehigh, and Northampton [2]			111,588	125,273	43
Total, 1935	2,745,984	3,495,908	52,158,783	210,130,565	103,269
Total, 1934	3,126,033	4,138,096	57,168,291	244,152,245	109,050
Change, 1935 ... percent	−12.2	−15.5	−8.8	−13.9	−5.3

[1] Value given for shipments is value at which coal left possession of producing company f. o. b. mines and does not include margins of separately incorporated sales companies.
[2] Counties producing dredge coal only.

FRESH-MINED AND CULM-BANK COAL, BREAKER AND WASHERY PRODUCT

Anthracite is now produced from three sources—from mines, from old culm banks, and from the rivers that drain the anthracite region. As all three sources contribute to the country's supply, it is important to consider them all to ascertain the total production. No difficulty is experienced in separating the figures of production by dredges. It is difficult to draw a sharp line that can be maintained throughout the statistics of the industry, however, between the fresh-mined and the culm-bank coal.

As the best solution of this problem, the producing companies are asked to supply separate statements for each breaker, washery, or dredge. These are totaled to form the primary tables of this report to show the total quantity of breaker product, washery product, and dredge product, with related figures of value, number of employees, and time worked.

The figures of breaker and washery product, however, are not exactly equivalent to the fresh-mined and culm-bank coal because of the practice sometimes adopted of putting culm-bank coal through a breaker, either directly from the bank or after preliminary treatment in a washery.

In 1935, the total washery product was reported as 2,106,969 net tons. In addition, a total of 617,350 tons of culm-bank coal was treated at breakers. Of this, 192,790 tons was handled in the Lehigh district, 188,584 tons in the Schuylkill district, and 235,976 tons in the Wyoming district.

A record, by fields, of the culm-bank coal put through breakers is given in table 9A.

TABLE 9A.—*Culm-bank coal put through breakers, by fields, 1929–35, in net tons*

Year	Northern	Eastern Middle	Western Middle	Southern	Total [1]
1929	73,000	15,000	116,000	223,000	427,000
1930	75,000	7,000	58,000	52,000	192,000
1931	96,000	70,000	57,000	307,000	530,000
1932	159,000	82,000	328,000	215,000	784,000
1933	479,000	212,000	559,000	293,000	1,543,000
1934	323,000	131,000	369,000	139,000	962,000
1935	236,000	143,000	61,000	177,000	617,000

[1] No culm-bank coal is put through breakers in Sullivan County.

SHIPMENTS, BY REGIONS AND SIZES

TABLE 10A.—*Pennsylvania anthracite shipped, by regions and sizes, in 1935*

[Figures of shipments from breakers include 617,000 tons of culm-bank coal handled in the breakers]

Size	Breaker shipments						Washery shipments	Dredge shipments	Grand total
	Lehigh region	Schuylkill region	Wyoming region	Total (excluding Sullivan County)	Sullivan County	Total (including Sullivan County)			
Net tons									
Lump [1] and broken	26,965	52,615	71,626	151,206		151,206			151,206
Egg	358,559	728,295	2,028,224	3,115,078	4,028	3,119,106	1,632		3,120,738
Stove	1,428,189	2,388,001	5,827,345	9,643,535	20,189	9,663,724	34,217		9,697,941
Chestnut	1,767,403	3,116,355	6,679,338	11,563,096	18,582	11,581,678	149,102		11,730,780
Pea	826,483	1,377,294	2,529,394	4,733,171	10,292	4,743,463	209,524		4,952,987
Total domestic	4,407,599	7,662,560	17,135,927	29,206,086	53,091	29,259,177	394,475		29,653,652
Buckwheat No. 1	1,134,158	2,094,669	3,456,987	6,685,814	12,223	6,698,037	509,945	3,970	7,211,952
Buckwheat No. 2 (rice)	609,185	1,270,014	2,225,563	4,104,762	26,775	4,131,537	400,641	10,221	4,542,399
Buckwheat No. 3 (barley)	603,260	1,373,742	1,453,504	3,430,506	5,573	3,436,079	464,057	198,394	4,098,530
Buckwheat No. 4	184,989	376,735	211,444	773,168	535	773,703	24,643	128,914	927,260
Boiler								14,120	14,120
Other		1,604	64,267	65,871	4,881	70,752	641	18,523	89,916
Total steam	2,531,592	5,116,764	7,411,765	15,060,121	49,987	15,110,108	1,399,927	374,142	16,884,177
Grand total	6,939,191	12,779,324	24,547,692	44,266,207	103,078	44,369,285	1,794,402	374,142	46,537,829
Value									
Lump [1] and broken	$136,272	$276,229	$367,376	$779,877		$779,877			$779,877
Egg	1,933,810	3,952,528	11,070,468	16,956,806	$19,306	16,976,112	$8,216		16,984,328
Stove	8,400,009	13,944,785	34,246,266	56,591,060	93,357	56,684,417	162,036		56,846,453
Chestnut	10,061,113	17,673,592	37,502,113	65,236,818	85,198	65,322,016	677,206		65,999,222
Pea	3,474,856	5,640,814	10,586,448	19,702,118	37,013	19,739,131	833,047		20,572,178
Total domestic	24,006,060	41,487,948	93,772,671	159,266,679	234,874	159,501,553	1,680,505		161,182,058
Buckwheat No. 1	3,330,027	5,743,396	10,167,652	19,241,075	29,633	19,270,708	1,381,036	$9,017	20,660,761
Buckwheat No. 2 (rice)	1,114,953	2,090,194	3,935,985	7,141,132	27,642	7,168,774	657,008	10,838	7,836,620
Buckwheat No. 3 (barley)	685,322	1,286,851	1,726,301	3,698,474	5,220	3,703,694	469,903	152,091	4,325,688

TABLE 10A.—*Pennsylvania anthracite shipped, by regions and sizes, in 1935*—Continued

Size	Breaker shipments						Washery shipments	Dredge shipments	Grand total
	Lehigh region	Schuylkill region	Wyoming region	Total (excluding Sullivan County)	Sullivan County	Total (including Sullivan County)			
Value—Continued									
Buckwheat No. 4	$65,683	$214,471	$121,682	$401,836	$282	$402,118	$12,495	$77,265	$491,878
Boiler								19,720	19,720
Other		1,038	71,960	72,998	2,674	75,672	543	9,690	85,905
Total steam	5,195,985	9,335,950	16,023,580	30,555,515	65,451	30,620,966	2,520,985	278,621	33,420,572
Grand total	29,202,045	50,823,898	109,796,251	189,822,194	300,325	190,122,519	4,201,490	278,621	194,602,630
Average value per ton									
Lump [1] and broken	$5.05	$5.25	$5.13	$5.16		$5.16			$5.16
Egg	5.39	5.43	5.46	5.44	$4.79	5.44	$5.03		5.44
Stove	5.88	5.84	5.88	5.87	4.62	5.87	4.74		5.86
Chestnut	5.69	5.67	5.61	5.64	4.58	5.64	4.54		5.63
Pea	4.20	4.10	4.19	4.16	3.60	4.16	3.98		4.15
Total domestic	5.45	5.41	5.47	5.45	4.42	5.45	4.26		5.44
Buckwheat No. 1	2.94	2.74	2.94	2.88	2.42	2.88	2.71	$2.27	2.86
Buckwheat No. 2 (rice)	1.83	1.65	1.77	1.74	1.03	1.74	1.64	1.06	1.73
Buckwheat No. 3 (barley)	1.14	.94	1.19	1.08	.94	1.08	1.01	.77	1.06
Buckwheat No. 4	.36	.57	.58	.52	.53	.52	.51	.60	.53
Boiler								1.40	1.40
Other		.65	1.12	1.11	.55	1.07	.85	.52	.96
Total steam	2.05	1.82	2.16	2.03	1.31	2.03	1.80	.74	1.98
Grand total	4.21	3.98	4.47	4.29	2.91	4.29	2.34	.74	4.18

[1] The quantity of lump included is insignificant.

TRENDS IN SIZES SHIPPED

TABLE 11A.—*Sizes of Pennsylvania anthracite shipped from breakers, by regions, 1933–35, in percent of total*

[Note that shipments of dredge and washery coal are not included]

Size of coal	Percent of total shipments								
	Lehigh region			Schuylkill region			Wyoming region		
	1933	1934	1935	1933	1934	1935	1933	1934	1935
Lump [1] and broken	0.4	0.4	0.4	0.6	0.4	0.4	0.3	0.2	0.3
Egg	5.9	5.4	5.2	7.0	6.7	5.7	10.2	9.3	8.3
Stove	21.6	21.0	20.6	19.6	19.5	18.7	24.8	24.7	23.7
Chestnut	22.9	24.7	25.4	21.8	23.6	24.4	25.4	26.9	27.2
Pea	11.8	12.5	11.9	10.2	10.2	10.8	9.7	10.2	10.3
Total domestic	62.6	64.0	63.5	59.2	60.4	60.0	70.4	71.3	69.8
Buckwheat No. 1	16.4	16.4	16.3	16.8	16.7	16.4	13.9	14.1	14.1
Buckwheat No. 2 (rice)	9.7	8.5	8.8	9.8	9.0	9.9	8.4	8.5	9.0
Buckwheat No. 3 (barley)	9.0	9.1	8.7	10.6	11.0	10.7	6.0	5.0	5.9
Boiler	------	------	------	------	------	------	.2	(2)	------
Other, including Buckwheat No. 4	2.3	2.0	2.7	3.6	2.9	3.0	1.1	1.1	1.2
Total steam	37.4	36.0	36.5	40.8	39.6	40.0	29.6	28.7	30.2
	Total, excluding Sullivan County			Sullivan County			Grand total		
Lump [1] and broken	0.4	0.3	0.4	1.7	------	------	0.4	0.3	0.3
Egg	8.5	7.9	7.0	7.9	4.4	3.9	8.5	7.9	7.0
Stove	22.8	22.4	21.8	16.9	19.0	19.6	22.8	22.4	21.8
Chestnut	24.0	25.5	26.1	20.4	23.6	18.0	24.0	25.5	26.1
Pea	10.2	10.6	10.7	15.7	14.5	10.0	10.2	10.6	10.7
Total domestic	65.9	66.7	66.0	62.6	61.5	51.5	65.9	66.7	65.9
Buckwheat No. 1	15.2	15.3	15.1	8.5	12.2	11.9	15.2	15.3	15.1
Buckwheat No. 2 (rice)	9.0	8.6	9.3	1.5	8.0	26.0	8.9	8.6	9.3
Buckwheat No. 3 (barley)	7.8	7.6	7.7	0.9	11.7	5.4	7.8	7.6	7.8
Boiler	0.1	(2)	------	------	------	------	.1	(2)	------
Other, including Buckwheat No. 4	2.0	1.8	1.9	26.5	6.6	5.2	2.1	1.8	1.9
Total steam	34.1	33.3	34.0	37.4	38.5	48.5	34.1	33.3	34.1

[1] The quantity of lump included is insignificant.
[2] Less than 0.1 percent.

TRENDS IN VALUES AND PRICES

SOURCES OF INFORMATION AND METHODS OF ANALYSIS

Margins of sales agents not included.—The valuation figures in this study represent value at the breaker or washery reported by the operating companies. In making its report, the company is requested to "estimate value of the product not sold" and to "exclude selling expenses."

From this it will be seen that when a producing company sells its output to a separately organized sales company (the practice of many, including certain of the larger producers), the value reported will exclude the margin of the sales company and may therefore be somewhat less than the circular price at which the coal in question is placed on the general market. This fact should be borne in mind in considering the variations in value between different regions shown in the tables for the same sizes of coal. (See table 12A.)

Estimates included in figures of value.—The reports are furnished in writing and signed by responsible officers of the mining companies. If a mine known to have produced coal during the year will make no report of value, an estimate is included in the total to make it complete. In 1935 the proportion of the total value of product represented by such estimates was 2.6 percent, as all operators except a few small producers supplied the information in detail.

AVERAGE SALES REALIZATIONS

The average sales realizations on each size from 1933 to 1935 are given in table 12A. To insure comparability the table is based on shipments of breaker coal only, the dredge and washery product being excluded.

The average realization on breaker shipments in 1935, all sizes combined, was $4.29 per net ton, a decrease of 24 cents per ton compared with the 1934 average of $4.53. The 1935 average sales realization was the lowest obtained by anthracite operators since 1918.

In the domestic sizes there was a marked decrease in the price obtained for all sizes. The average mine price of all steam sizes increased from $1.98 in 1934 to $2.03 in 1935, chiefly because of the higher price realized on Buckwheat No. 2.

TABLE 12A.—*Average sales realization per net ton on Pennsylvania anthracite shipments from breakers, by regions and sizes, 1933–35*

[Value does not include margins of separately incorporated sales companies]

Size	Lehigh region			Schuylkill region			Wyoming region		
	1933	1934	1935	1933	1934	1935	1933	1934	1935
Lump [1] and broken	$4.72	$4.95	$5.05	$5.47	$5.55	$5.25	$5.74	$5.55	$5.13
Egg	5.81	5.92	5.39	5.80	5.84	5.43	5.96	5.89	5.46
Stove	6.20	6.28	5.88	6.17	6.18	5.84	6.29	6.25	5.88
Chestnut	5.96	6.05	5.69	5.92	5.99	5.67	5.97	5.96	5.61
Pea	4.18	4.43	4.20	4.15	4.28	4.10	4.27	4.47	4.19
Total domestic	5.68	5.79	5.45	5.68	5.74	5.41	5.85	5.84	5.47
Buckwheat No. 1	2.87	2.93	2.94	2.73	2.77	2.74	2.90	2.91	2.94
Buckwheat No. 2 (rice) [2]	1.60	1.61	1.83	1.39	1.43	1.65	1.53	1.64	1.77
Buckwheat No. 3 (barley)	1.04	1.04	1.14	.84	.84	.94	1.13	1.09	1.19
Total, steam [3]	1.96	2.00	2.05	1.72	1.78	1.82	2.06	2.14	2.16
Total, all sizes	4.29	4.43	4.21	4.06	4.17	3.98	4.73	4.78	4.47

Size	Total, excluding Sullivan County			Sullivan County			Grand total		
	1933	1934	1935	1933	1934	1935	1933	1934	1935
Lump [1] and broken	$5.45	$5.43	$5.16	$2.00			$5.43	$5.43	$5.16
Egg	5.90	5.88	5.44	5.13	$4.51	$4.79	5.90	5.88	5.44
Stove	6.25	6.24	5.87	5.00	3.69	4.62	6.25	6.23	5.87
Chestnut	5.95	5.98	5.64	5.12	3.42	4.58	5.95	5.98	5.64
Pea	4.22	4.40	4.16	3.96	2.48	3.60	4.22	4.40	4.16
Total, domestic	5.78	5.80	5.45	4.71	3.36	4.42	5.78	5.80	5.45
Buckwheat No. 1	2.84	2.86	2.88	3.49	1.45	2.42	2.84	2.86	2.88
Buckwheat No. 2 (rice) [2]	1.50	1.57	1.74	1.53	.81	1.03	1.50	1.56	1.74
Buckwheat No. 3 (barley)	1.00	.97	1.08	1.13	.88	.94	1.00	.97	1.08
Total, steam [3]	1.93	1.98	2.03	1.64	1.14	1.31	1.93	1.98	2.03
Total, all sizes	4.46	4.53	4.29	3.56	2.50	2.91	4.46	4.53	4.29

[1] The quantity of lump included is insignificant. [2] Includes birdseye. [3] Includes all other steam sizes.

AVERAGE VALUES OF SHIPMENTS, LOCAL SALES, AND COLLIERY FUEL

TABLE 13A.—*Average value per net ton of Pennsylvania anthracite shipped, local sales, colliery fuel, and total production, by regions, 1934–35* [1]

[Note that values in this table include washery and dredge coal]

Year and region	1934 Shipments	1934 Local sales	1934 Colliery fuel	1934 Total production	1935 Shipments	1935 Local sales	1935 Colliery fuel	1935 Total production
Lehigh	$4.39	$4.72	$1.62	$4.24	$4.17	$4.60	$1.60	$4.05
Schuylkill	4.02	3.54	1.50	3.90	3.74	3.40	1.44	3.64
Wyoming	4.76	4.52	1.19	4.52	4.45	4.53	1.14	4.25
Total, excluding Sullivan County	4.53	4.49	1.33	4.36	4.29	4.48	1.27	4.15
Sullivan County	2.50	4.22	.89	2.90	2.91	3.90	1.02	3.17
Grand total	4.46	4.19	1.32	4.27	4.18	4.19	1.27	4.03

[1] Value given for shipments is value at which coal left possession of producing company f. o. b. mines and does not include margins of separately incorporated sales companies.

NUMBER OF OPERATIONS

Due to the many changes in anthracite practices during the past few years, particularly with regard to concentration of preparation at central breakers, it has not been possible to make the figures on number of active plants comparable with earlier years. However, in 1935 an effort was made to make an accurate count of the number of active operations. The results are shown in table 14A.

TABLE 14A.—*Number of active operations in the Pennsylvania anthracite industry, 1935*

District and type of product	Total active plants reporting [1]	Breakers [2]	Other preparation plant [3]	Washeries [4]	Culm banks operated in conjunction with breakers	Dredges	Reporting strip-pit tonnage
Anthracite region, excluding Sullivan County							
Lehigh:							
Breakers or mines	35	25			6		29
Dredges	2		1			2	
Total	37	25	1		6	2	29
Schuylkill:							
Breakers or mines	63	37	17		13		29
Washeries	20		2	6			1
Dredges	28		18			28	
Total	111	37	37	6	13	28	30
Wyoming:							
Breakers or mines	181	74	6		8		30
Washeries	14			2			
Dredges	1		1			1	
Total	196	74	7	2	8	1	30
Total, excluding Sullivan County:							
Breakers	279	136	23		27		88
Washeries	34		2	8			1
Dredges	31		20			31	
Total	344	136	45	8	27	31	89
Sullivan County: Breakers	6	6					2
Grand total	350	142	45	8	27	31	91

[1] The number of active plants contains numerous duplications, that is, successions known and unknown, and leases and subleases. Each report received which was tabulated for production or for employment has been counted separately.
[2] Equipped to prepare standard sizes of fresh-mined coal.
[3] For preliminary crushing, screening, or cleaning. Usually old breakers are used for this purpose. The number reported for dredges represents reports showing men employed at tipple.
[4] Preparation plant for the sizing and cleaning of culm-bank coal.

LABOR STATISTICS

TABLE 15A.—*Men employed and days worked at operations producing Pennsylvania anthracite in 1935*

[Includes operations of strip contractors]

District	Average number of men employed								Average number of days plant operated	Man-days of labor	Average tons per man per day
	Underground			Surface							
	Miners and their laborers	Other	Total underground	In strip pits	In preparation plant	Other	Total surface	Grand total			
Anthracite region, excluding Sullivan County											
Lehigh:											
Breaker product	8,091	3,882	11,973	1,611	1,717	2,880	6,208	18,181	168	3,059,851	2.50
Dredge product					6	19	25	25	177	4,430	17.74
Total	8,091	3,882	11,973	1,611	1,723	2,899	6,233	18,206	168	3,064,281	2.52
Schuylkill:											
Breaker product	11,315	6,592	17,907	1,949	2,076	3,545	7,570	25,477	199	5,058,290	2.75
Washery product				7	242	413	662	662	204	135,284	[1] 11.70
Dredge product					70	171	241	241	145	34,878	14.13
Total	11,315	6,592	17,907	1,956	2,388	4,129	8,473	26,380	198	5,228,452	3.06
Wyoming:											
Breaker product	33,095	14,728	47,823	513	2,833	6,870	10,216	58,039	191	11,106,402	2.49
Washery product					26	79	105	105	148	15,589	[1] 9.51
Dredge product					7	8	15	15	173	2,595	7.41
Total	33,095	14,728	47,823	513	2,866	6,957	10,336	58,159	191	11,124,586	2.54
Total, excluding Sullivan County:											
Breaker product	52,501	25,202	77,703	4,073	6,626	13,295	23,994	[2] 101,697	189	[2] 19,224,543	2.56
Washery product				7	268	492	767	[2] 767	197	[2] 150,873	13.97
Dredge product					83	198	281	281	149	41,903	14.09
Total	52,501	25,202	77,703	4,080	6,977	13,985	25,042	102,745	189	19,417,319	2.68
Sullivan County: Breaker product	241	114	355	11	66	92	169	524	131	68,455	2.78
Grand total	52,742	25,316	78,058	4,091	7,043	14,077	25,211	103,269	189	19,485,774	2.68

[1] Represents washeries for which both production and employment were separately reported.
[2] The men shown for "breaker product" include a considerable number of washery employees who could not be separated from breaker employees.

TABLE 16A.—*Strikes, suspensions, and lock-outs in the Pennsylvania anthracite region in 1935*

	Lehigh	Schuylkill	Wyoming	Total, excluding Sullivan County	Sullivan County	Grand total
Total number employed	18,206	26,380	58,159	102,745	524	103,269
Men on strike	11,218	7,348	7,561	26,127		26,127
Man-days lost on account of strike	177,272	267,679	318,356	763,307		763,307
Average days lost—						
Per man employed	9.7	10.1	5.5	7.4		7.4
Per man on strike	15.8	36.4	42.1	29.2		29.2

EQUIPMENT AND METHODS OF MINING

TABLE 17A.—*Relative growth of mechanical loading, hand loading, and stripping in Pennsylvania anthracite mines, 1927–35*

[Mechanical loading includes coal handled on pit-car loaders and hand-loaded face conveyors]

Year	Mechanical loading underground	Stripping	Hand loading	Year	Mechanical loading underground	Stripping	Hand loading
Net tons:				Index numbers:			
1927	[1] 2,223,000	2,153,000	71,435,000	1927	100	100	100
1928	[1] 2,351,000	2,423,000	67,374,000	1928	106	113	94
1929	3,470,000	1,912,000	66,494,000	1929	156	89	93
1930	4,468,000	2,536,000	60,458,000	1930	201	118	85
1931	4,385,000	3,813,000	49,075,000	1931	197	177	69
1932	5,433,000	3,981,000	38,401,000	1932	244	185	54
1933	6,557,000	4,932,000	34,475,000	1933	295	229	48
1934	9,284,000	5,798,000	39,290,000	1934	418	269	55
1935	9,279,000	5,187,000	34,400,000	1935	417	241	48

[1] As reported by the Commonwealth of Pennsylvania, Department of Mines.

TABLE 18A.—*Pennsylvania anthracite loaded mechanically underground, 1927–35*

Year	Scrapers and mobile loaders		Conveyors and pit-car loaders [1]		Total loaded mechanically	
	Number of units	Net tons loaded	Number of units	Net tons handled	Number of units	Net tons handled
1927 [2]	305	(3)	159	(3)	464	2,223,281
1928 [2]	302	(3)	184	(3)	486	2,351,074
1929	350	2,450,279	355	1,019,879	705	3,470,158
1930	384	2,927,088	421	1,540,662	805	4,467,750
1931	462	2,462,370	576	1,922,410	1,038	4,384,780
1932	490	2,651,591	859	2,781,749	1,349	5,433,340
1933	464	2,395,403	965	4,161,864	1,429	6,557,267
1934	531	3,017,741	1,376	6,266,745	1,907	9,284,486
1935	508	2,662,026	1,615	6,617,031	2,123	9,279,057

[1] Includes duckbills and other self-loading conveyors, which account for only a small part of the total.
[2] As reported by the Commonwealth of Pennsylvania, Department of Mines.
[3] Not separately reported; see total.

TABLE 19A.—*Change in tonnage of Pennsylvania anthracite loaded by principal types of machines, 1933-35*

	1933	1934	1935	Increase (+) or decrease (−), 1935 over 1934	
	Net tons	*Net tons*	*Net tons*	*Net tons*	*Percent*
Mobile loading machines	48, 078	37, 227	2, 662, 026	−355, 715	−11. 8
Scraper loaders	2, 347, 325	2, 980, 514			
Pit-car loaders	62, 586	63, 106	60, 045	−3, 061	−4. 9
Hand-loaded face conveyors [1]	4, 099, 278	6, 203, 639	6, 556, 986	+353, 347	+5. 7
Total	6, 557, 267	9, 284, 486	9, 279, 057	−5, 429	−0. 1

[1] Shaker chutes, etc., including those equipped with duckbills.

TABLE 20A.—*Pennsylvania anthracite handled by mobile loaders and scrapers and by all types of conveyors in 1935, by fields, in net tons*

Field	Scraper loaders	Pit-car loaders	Hand-loaded face-conveyors, all types [1]	Total mechanically loaded underground
Northern	2, 169, 149	34, 806	5, 227, 363	7, 416, 776
Eastern Middle	91, 814		321, 930	428, 286
Western Middle	371, 078	25, 239	866, 197	1, 242, 705
Southern	[2] 29, 985		141, 496	191, 290
Total	2, 662, 026	60, 045	6, 556, 986	9, 279, 057

[1] Shaker chutes, etc., including those equipped with duckbills.
[2] Includes tonnage by mobile loaders.

TABLE 21A.—*Pennsylvania anthracite cut by machines, 1934-35*

Region	1934			1935		
	Number of cutting machines		Net tons cut by machines	Number of cutting machines		Net tons cut by machines
	Permissible	All other types		Permissible	All other types	
Lehigh	1		5, 000	3		20, 190
Schuylkill	4	6	66, 829	9		44, 377
Wyoming	132	24	1, 905, 156	91	97	1, 774, 716
Total, excluding Sullivan County	137	30	1, 976, 985	103	97	1, 839, 283
Sullivan County	2	0	4, 103	2	1	8, 812
Grand total	139	30	1, 981, 088	105	98	1, 848, 095

TABLE 22A.—*Relative growth of Pennsylvania anthracite mined from strip pits, 1915–35, in net tons*

Year	Number of power shovels in use [1]	Quantity mined by stripping: Total	Quantity mined by stripping: Average per shovel	Percent of fresh-mined total that was stripped	Number of men employed	Average number of days worked
1915	57	1,121,603	19,677	(2)	(2)	(2)
1920	96	2,054,441	21,400	2.5	(2)	(2)
1925	97	1,578,478	16,273	2.7	(2)	(2)
1930	108	2,536,288	23,484	3.7	(2)	(2)
1931	189	3,813,237	20,176	6.7	2,232	(2)
1932	234	3,980,973	17,013	8.3	2,407	190
1933	319	4,932,069	15,461	10.7	3,383	195
1934	349	5,798,138	16,614	10.7	4,304	218
1935:						
Lehigh district	126	1,994,701	15,831	26.7	1,611	248
Schuylkill district	151	2,471,778	16,369	17.9	1,956	224
Wyoming district	60	702,299	11,705	2.6	513	218
Total, excluding Sullivan County	337	5,168,778	15,338	10.6	4,080	233
Sullivan County	2	18,294	9,147	9.6	11	114
Grand total	[3] 339	5,187,072	15,301	10.6	4,091	233

[1] Certain of the equipment reported by stripping contractors may have been counted twice when moved from one small job to another during the year. The amount of such double counting is unknown but presumably is not great.
[2] Data not available.
[3] Includes 147 gasoline, 39 steam, 85 electric, and 68 other types of shovels.

DREDGE OPERATIONS

Average receipts per net ton on all dredge coal sold, 1930–35

1930	$0.84	1933	$0.84
1931	.83	1934	.98
1932	.93	1935	.88

TABLE 23A.—*Anthracite produced by dredges, by rivers, 1934–35*

River (incuding tributaries)	1934: Number of dredges	1934: Net tons	1934: Value	1935: Number of dredges	1935: Net tons	1935: Value
Lehigh	2	91,346	$110,587	2	78,578	$90,224
Schuylkill	4	100,873	61,010	3	73,326	61,886
Susquehanna	28	459,961	464,441	26	438,563	365,194
Total	34	652,180	636,038	31	590,467	517,304

IMPORTS AND EXPORTS

TABLE 24A.—*Anthracite imported, by countries, 1934–35, in net tons*

Country	1934	1935	Country	1934	1935
Canada	2,098	5,159	United Kingdom	152,694	170,867
U. S. S. R. (Russia) in Europe	323,326	395,413	Total	478,118	571,439

TABLE 25A.—*Anthracite imported, by customs district, 1934–35 in net tons*

Customs district	1934	1935
Buffalo	640	
Connecticut	17,892	18,631
Dakota	5	12
Maine and New Hampshire	34,735	36,948
Massachusetts	331,073	410,168
Oregon	3	
Rhode Island	93,564	92,975
Virgin Islands		9,429
Washington	206	3,276
Total	478,118	571,439

TABLE 26A.—*Anthracite exported, by countries, 1934–35, in net tons*

Country	1934	1935
North America:		
Canada	1,266,462	1,592,368
Central America:		
Guatemala	5	
Honduras	11	22
Nicaragua		2
Salvador	2	
Mexico	203	193
Miquelon and St. Pierre Islands	131	38
Newfoundland and Labrador	5,003	4,853
West Indies:		
British:		
Bermuda	1,119	1,375
Other British	196	170
Cuba	4,659	
Dominican Republic		3
Netherland West Indies		22
South America:		
Bolivia	52	
Columbia	1,125	991
Venezuela	4	
Europe:		
Italy	18,162	7,279
Sweden		2
United Kingdom	1	
Asia: Philippine Islands		1,231
Oceania: New Zealand	475	
Total	1,297,610	1,608,549

TABLE 27A.—*Anthracite exported, by customs districts and ports, 1934–35, in net tons*

Customs district	1934	1935
North Atlantic:		
Massachusetts	26	74
New York	23,128	23,283
Philadelphia	104,252	48,361
South Atlantic:		
Florida	82	88
Maryland		39
New Orleans	11	25
Mexican Border:		
Arizona	38	10
El Paso	152	159
San Antonio	1	2
Pacific Coast:		
Washington		109
San Francisco	2	
San Diego	11	21
Lake Erie ports: Ohio [1]	14,294	15,103
Rail gateways on Canadian border:		
Eastern:		
Maine and New Hampshire	258	116
Vermont	542	784
St. Lawrence	432,513	385,460
Rochester [2]	95,578	59,370
Buffalo	616,612	1,066,415
Michigan	3,570	3,161
Western:		
Duluth, Superior, and International Falls	5,685	5,238
Dakota	855	729
Miscellaneous: Puerto Rico		2
Total	1,297,610	1,608,549

[1] Chiefly Buffalo and Erie.

[2] Rail, car ferry, and Lake Ontario.

COKE AND BYPRODUCTS

By W. H. Young, H. L. Bennit, and M. Otero

SUMMARY OUTLINE

The coke industry made marked progress in 1936. The total value of all the products of the coke industry in 1936 was $368,652,221, a gain of $78,243,789 (27 percent) over 1935. Production of coke was 46,275,184 net tons, an increase of 32 percent compared with 1935. Byproduct ovens operated at 72 percent capacity compared with 55 percent in 1935 and 34 percent in 1932.

The average price of byproduct coke was $5.06 per net ton in 1936, the same as in 1935. The average value of beehive coke also remained the same in 1936 as in 1935, namely, $3.91 per net ton. The average price of coal charged in byproduct ovens decreased from $3.82 in 1935 to $3.69 in 1936. The amount of coal needed to make 1 ton of byproduct coke was 1.42 tons and the cost was $5.24 compared with 1.43 tons costing $5.46 in 1935. The amount of coal needed to make 1 ton of beehive coke was 1.58 tons and the cost was $2.94 compared with 1.60 tons costing $2.85 in 1935. (See fig. 60.)

The increase of 32 percent in coke production is due largely to the increase of 46 percent in pig-iron production. Production of byproduct coke at furnace plants was 32,076,089 net tons, an increase of 39 percent over 1935. This directly reflects the increase in pig-iron production in 1936.

Although the total production of coke in 1936 was only 77 percent of that in the year of peak production (1929) it is significant that the trend has been definitely upward since the low of 1932, when production was only 36 percent of the 1929 output. (See fig. 57.)

In 1936, 1,471 beehive ovens were abandoned, and byproduct coke represented 96.3 percent of the total production compared with 97.4 percent in 1935.

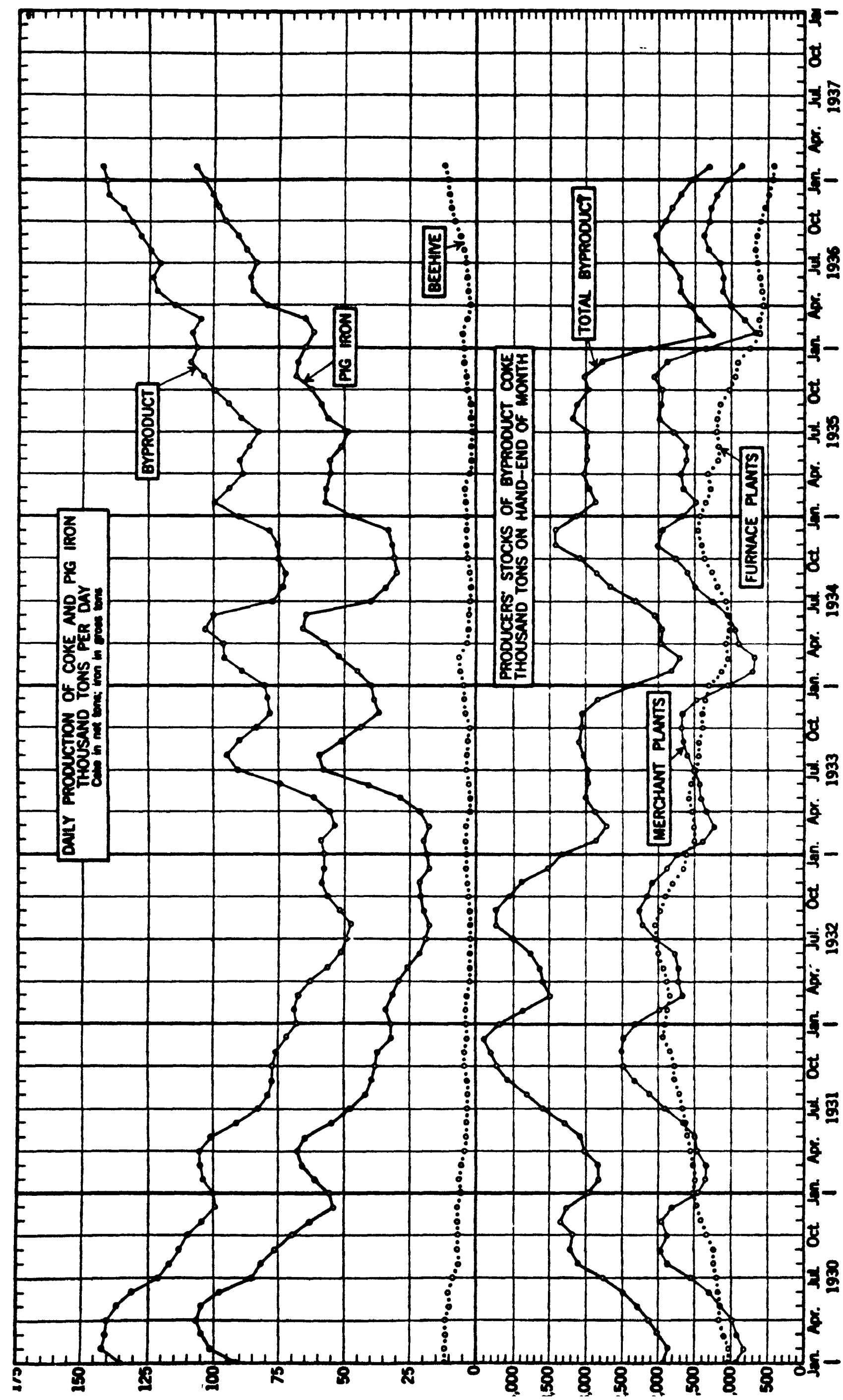


FIGURE 57.—Average daily production of beehive and byproduct coke and pig iron, also producers' stocks of byproduct coke, 1930–37, by months.

The total value of products resulting from carbonization of coal in byproduct ovens (coke, byproducts, and breeze) was $361,935,207 compared with a total cost for coal charged into coke ovens of $233,224,305. This represents an enhancement of $128,710,902 in value or 55 percent more than the cost of the raw material.

Sales of domestic coke, which have grown steadily and consistently up to and including 1933, remained about the same in 1934, declined in 1935, and increased slightly in 1936. Sales increased from 9,426,386 net tons in 1935 to 10,021,343 in 1936. Average value of domestic coke at byproduct ovens was $5.84 per ton in 1935 and $6.07 per ton in 1936.

STATISTICAL SUMMARY

TABLE 1.—*Salient statistics of the coke industry in 1936*

	Byproduct	Beehive	Total
Coke produced:			
At merchant plants:			
Quantity net tons	12,493,032		12,493,032
Value	$77,883,017		$77,883,017
At furnace plants:			
Quantity net tons	32,076,089		32,076,089
Value	$147,812,702		$147,812,702
Total:			
Quantity net tons	44,569,121	1,706,063	46,275,184
Value	$225,695,719	$6,678,272	$232,373,991
Screenings or breeze produced:			
Quantity net tons	3,577,222	61,349	3,638,571
Value	$7,265,615	$38,742	$7,304,357
Coal charged into ovens:			
Quantity net tons	63,243,517	2,698,158	65,941,675
Value	$233,224,305	$5,020,927	$238,245,232
Average value per ton	$3.69	$1.86	$3.61
Average yield in percent of coal charged:			
Coke	70.47	63.23	70.18
Breeze (at plants actually recovering)	5.66	4.01	5.62
Ovens:			
In existence Jan. 1	12,860	13,674	26,534
In existence Dec. 31	12,849	13,012	25,861
Dismantled during year	40	1,471	1,511
In course of construction Dec. 31	305		305
Daily capacity of ovens Dec. 31 net tons	170,070	(1)	(1)
Coke used by operator:			
In blast furnaces:			
Quantity net tons	26,014,701		26,014,701
Value	$118,365,003		$118,365,003
To make producer or water gas:			
Quantity net tons	1,459,233		1,459,233
Value	$8,159,808		$8,159,808
For other purposes:			
Quantity net tons	571,868		571,868
Value	$3,057,077		$3,057,077
Disposition of coke:			
Sold to financially affiliated corporations:			
For blast-furnace use:			
Quantity net tons	2,045,510	158,476	2,203,986
Value	$8,621,454	$700,439	$9,321,893
For all other purposes:			
Quantity net tons	439,978	12,345	452,323
Value	$2,280,530	$58,234	$2,338,764
Sold to other consumers:			
For blast-furnace use:			
Quantity net tons	1,232,446	385,366	1,617,812
Value	$6,269,072	$1,409,381	$7,678,453
For foundry use:			
Quantity net tons	1,672,538	249,279	1,921,817
Value	$12,439,148	$1,195,719	$13,634,867
For manufacture of water gas:			
Quantity net tons	360,646	24,352	384,998
Value	$2,348,700	$97,487	$2,446,187
For other industrial use:			
Quantity net tons	1,152,042	495,734	1,647,776
Value	$5,984,353	$1,896,996	$7,881,349
For domestic use:			
Quantity net tons	9,643,507	377,836	10,021,343
Value	$58,494,793	$1,312,998	$59,807,791

[1] Data not available.

TABLE 1.—*Salient statistics of the coke industry in 1936*—Continued

	Byproduct	Beehive	Total
Disposition of screenings or breeze:			
Used by operator:			
For raising steam:			
Quantity net tons	2,581,230	133	2,581,363
Value	$5,111,445	$561	$5,112,006
To make producer or water gas:			
Quantity net tons	76,597		76,597
Value	$286,423		$286,423
For other purposes:			
Quantity net tons	292,813	24	292,837
Value	$571,309	$101	$571,410
Sold:			
Quantity net tons	697,918	46,377	744,295
Value	$1,477,045	$30,002	$1,507,047
Average receipts per ton sold:			
Furnace coke (merchant sales)	$5.09	$3.66	$4.75
Foundry coke	$7.44	$4.80	$7.09
Domestic coke	$6.07	$3.48	$5.97
For manufacture of water gas	$6.51	$4.00	$6.35
Other industrial coke	$5.19	$3.83	$4.78
Screenings or breeze	$2.12	$0.65	$2.02
Stocks on hand on Jan. 1, 1937:			
Furnace net tons	282,144	5,622	287,766
Foundry do	8,981	8,508	17,489
Domestic and other do	1,408,350	18,461	1,426,811
Breeze do	285,775	3,943	289,718
Exports do			670,312
Imports do			329,957
Calculated consumption do			47,032,147
Byproducts produced:			
Gas M cubic feet	699,701,415		699,701,415
Wasted percent	1.71		1.71
Burned in coking process do	36.32		36.32
Surplus sold or used do	61.97		61.97
Tar gallons	560,385,578		560,385,578
Ammonium sulphate or equivalent pounds	1,388,682,583		1,388,682,583
Crude light oil gallons	170,234,202		170,234,202
Yield of byproducts per ton of coal:			
Gas M cubic feet	11.06		11.06
Tar gallons	8.86		8.86
Ammonium sulphate or equivalent pounds	22.14		22.14
Crude light oil gallons	2.91		2.91
Value of byproducts sold:			
Gas (surplus)	$70,830,970		$70,830,970
Tar:			
Sold	$15,328,340		$15,328,340
Used by producer	$8,768,240		$8,768,240
Ammonium sulphate or equivalent	$12,812,979		$12,812,979
Crude light oil and derivatives	$18,938,777		$18,938,777
Other byproducts [1]	$2,294,567		$2,294,567
Total value of coke, breeze, and byproducts [2]	$361,935,207	$6,717,014	$368,652,221

[1] Includes naphthalene and tar derivatives.
[2] Includes value of tar used by the coke plants.

Scope of report.—The continuing need for economy in public expenditure impels the Bureau of Mines to confine this report to presenting, through selected tables, the essential facts of the statistical record for the year. If not readily found any derivative figures carried in earlier reports will be furnished by the Bureau upon application.

This report covers only coke made by high-temperature carbonization of coal in beehive and byproduct ovens. However, byproduct coke produced by city gas companies is included. (See fig. 58.) The essential product of these companies is manufactured gas, but in 1936 the production of byproduct coke by city gas companies constituted about 8 percent of the national production of byproduct coke. With respect to ownership and accounting these byproduct ovens are part of the gas utility system, and the Bureau of the Census therefore groups them within the manufactured-gas industry under

the title "The Gas and Coke Industries." In other respects, however, these ovens form part of the byproduct-coke industry and they are so included in the statistics of the Bureau of Mines. The differences in classification are followed advisedly by the Bureau of the Census and Bureau of Mines after consultation with leaders of the gas and coke industries, and the two offices have collaborated in the collection and analysis of the statistics. (See table 50.)

Coke is made by other processes not included in this chapter. In 1936 about 1,083,000 net tons of gas-house coke were made by high-temperature carbonization of coal in types of equipment other than coke ovens—chiefly horizontal retorts. About 1,378,200 net tons of petroleum coke, a byproduct of petroleum refining, were produced in 1936. The manufacture of coke from coal-tar pitch is

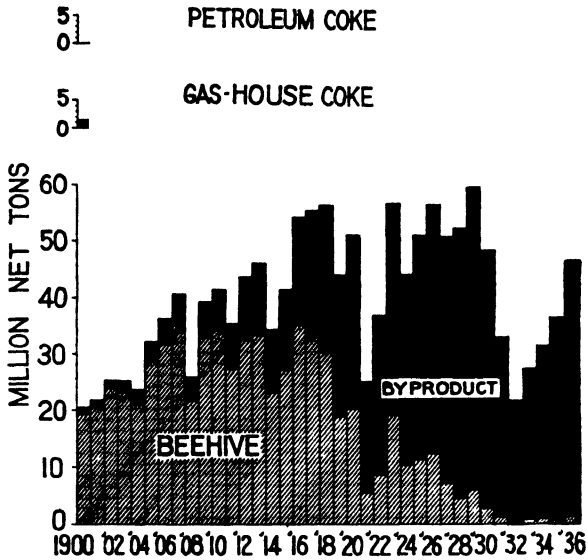


FIGURE 58.—Production of petroleum coke, gas-house coke, and beehive and byproduct coke in the United States, 1900–1936. No figures on production of petroleum coke are available before 1914, when the production was 213,777 tons.

established on a commercial basis but the tonnage produced is small. Within the last few years, also, production of a smokeless fuel by low-temperature carbonization of coal has been established commercially in the United States.[1] None of these other kinds of coke, however, are discussed in this report. Only coke from byproduct and beehive ovens is adapted to blast-furnace and foundry uses, which consume most of all coke produced. Practically, therefore, the coke trade is concerned only with beehive and byproduct-oven coke (fig. 58).

The standard unit of measurement in the coke industry is the short or net ton of 2,000 pounds, and unless otherwise specified this unit is employed throughout this report.

[1] See discussion of low-temperature carbonization in the chapter Recent Developments in Coal Preparation and Utilization, by A. C. Fieldner.

TABLE 2.—*Statistical trends of the coke industry, 1923 and 1933–36*

	1923	1933	1934	1935	1936
Coke produced:					
Beehive.........net tons..	19,379,870	911,058	1,028,765	917,208	1,706,063
Byproduct.........do....	37,597,664	26,678,136	30,792,811	34,224,053	44,569,121
Total.........do....	56,977,534	27,589,194	31,821,576	35,141,261	46,275,184
Percent of total from byproduct ovens.........	66.0	96.7	96.8	97.4	96.3
Stocks of producers, end of year, all coke net tons..	[1] 1,221,737	2,865,260	3,598,543	2,829,384	1,732,066
Exports, all coke.........do....	1,237,342	637,819	942,785	613,975	670,312
Imports, all coke [2].........do....	85,002	160,873	160,934	317,379	329,957
Consumption, calculated, all coke...do....	55,173,457	27,771,843	30,306,382	35,613,824	47,032,147
Disposal of coke (beehive and byproduct):					
Furnace coke (including all coke used by producer).........net tons..	47,774,408	14,822,568	17,504,745	22,586,613	28,218,687
Foundry coke.........do....	3,600,719	1,004,885	1,262,139	1,484,453	1,921,517
Other industrial (including water gas) net tons.	2,283,888	1,836,987	1,892,595	2,236,112	2,032,774
Domestic coke.........do....	2,733,414	10,491,037	10,520,295	9,426,386	10,021,343
Ovens:					
Beehive, in existence, end of year.........	62,349	16,857	14,206	13,674	13,012
Byproduct, in existence, end of year.....	11,156	13,053	12,963	12,860	12,849
Byproduct under construction, end of year.........	629	....	....	122	305
Cost of coal charged, byproduct ovens, average per ton.........	$4.76	$3.38	$3.70	$3.82	$3.69
Prices of coke:					
Average spot price of Connellsville furnace coke, f. o. b. ovens.........	$5.33	$2.41	$3.77	$3.61	$3.68
Average realization on byproduct coke sold:					
Furnace coke (merchant sales).........	$6.74	$4.00	$5.24	$4.77	$4.75
Foundry coke.........	$10.54	$5.34	$6.38	$6.96	$7.09
Other industrial (including water gas).	$9.06	$5.06	$5.57	$5.41	$5.08
Domestic.........	$9.05	$5.12	$5.83	$5.84	$5.97
Yield of byproducts per ton of coal charged:					
Tar.........gallons...	8.1	9.39	9.22	9.18	8.86
Ammonium sulphate or equivalent pounds..	21.2	22.18	22.29	22.59	22.14
Light oil.........gallons..	2.7	2.79	2.90	2.98	2.91
Surplus gas sold or used..M cubic feet..	5.9	7.14	6.98	7.04	6.86
Average gross receipts of byproducts per ton of coke produced:					
Tar sold or used.........	$0.51	$0.506	$0.520	$0.528	$0.541
Ammonia and its compounds.........	$0.84	$0.269	$0.284	$0.310	$0.287
Light oil and its derivatives.........	$0.51	$0.461	$0.434	$0.435	$0.425
Surplus gas sold or used.........	$1.37	$2.099	$1.924	$1.832	$1.589
Total byproducts, including breeze.........	$3.48	$3.549	$3.372	$3.317	$3.050

[1] Furnace and foundry coke only.
[2] Prior to 1934 the figures represent general imports; beginning with 1934 they represent imports for consumption only.

TABLE 3.—*Summary of coke produced, value, number of ovens, coal charged, and average yield in 1936, by States*

[Exclusive of screenings or breeze]

State	Byproduct							Beehive						Total	
	Plants in existence	Ovens in existence	Coal used (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens		Ovens in existence	Coal used (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens		Coke produced (net tons)	Value of coke at ovens
						Total	Per ton					Total	Per ton		
Alabama	8	1,248	4,435,328	69.66	3,089,622	$8,774,694	$2.84							3,089,622	$8,774,694
Colorado	1	151	505,908	66.68	337,341	(1)	(1)	188	93,941	65.25	61,293	(1)	(1)	398,634	(1)
Connecticut	1	61	(2)	(2)	(2)	(2)	(2)							(2)	(2)
Illinois	8	896	3,034,695	68.62	2,082,516	13,098,787	6.29							2,082,516	13,098,787
Indiana	6	1,548	7,410,152	73.54	5,449,755	40,627,036	7.45							5,449,755	40,627,036
Kentucky	1	108	(2)	(2)	(2)	(2)	(2)							(2)	(2)
Maryland	1	361	1,683,792	72.28	1,217,039	(1)	(1)							1,217,039	(1)
Massachusetts	3	430	1,566,576	70.74	1,108,219	6,766,722	6.11							1,108,219	6,766,722
Michigan	9	614	3,189,588	71.91	2,293,653	13,738,700	5.99							2,293,653	13,738,700
Minnestoa	3	196	753,396	69.22	521.518	4,120,984	7.90							521,518	4,120,984
Missouri	1	64	(2)	(2)	(2)	(2)	(2)							(2)	(2)
New Jersey	2	239	1,417,502	71.08	1,007,500	(1)	(1)							1,007,500	(1)
New York	9	1,024	6,730,448	71.85	4,835,921	28,566,271	5.91							4,835,921	28,566,271
Ohio	15	1,839	8,763,708	71.25	6,242,300	26,938,007	4.32							6,242,300	26,938,007
Pennsylvania	12	3,348	18,380,164	68.39	12,570,816	49,644,435	3.95	9,036	1,879,187	64.56	1,213,294	$4,565,024	$3.76	13,784,110	54,209,459
Rhode Island	1	65	(2)	(2)	(2)	(2)	(2)							(2)	(2)
Tennessee	1	24	120,816	68.95	83,305	376,539	4.52	161	6,886	51.80	3,567	20,831	5.84	86,872	397,370
Utah	1	56	218,594	56.88	124,346	(1)	(1)	819	9,754	57.59	5,617	(1)	(1)	129,963	(1)
Virginia								1,291	330,130	57.96	191,331	811,894	4.24	191,331	811,894
Washington	1	20	46,983	60.38	28,368	170,208	6.00	58	501	62.28	312	2,160	6.92	28,680	172,368
West Virginia	4	362	2,425,957	70.19	1,702,792	5,097,703	2.99	1,459	377,759	61.06	230,649	899,996	3.90	1,933,441	5,997,699
Wisconsin	2	195	(2)	(2)	(2)	(2)	(2)							(2)	(2)
Combined States			2,562,910	73.12	1,874,110	12,598,234	6.72							1,874,110	12,598,234
Undistributed						15,177,399	5.65					378,367			15,555,766
Grand total, 1936	90	12,849	63,243,517	70.47	44,569,121	225,695,719	5.06	13,012	2,698,158	63.23	1,706,063	6,678,272	3.91	46,275,184	232,373,991
Grand total, 1935	90	12,860	49,045,619	69.78	34,224,053	173,271,325	5.06	13,674	1,468,855	62.44	917,208	3,581,810	3.91	35,141,261	176,853,135
Change in 1936, percent		−0.1	+28.9	+1.0	+30.2	+30.3		−4.8	+83.7	+1.3	+86.0	+86.4		+31.7	+31.4

[1] Included under "Undistributed."

[2] Included under "Combined States."

Production of coke.—The total production of coke was 46,275,184 tons in 1936 compared with 35,141,261 tons in 1935, an increase of 32 percent. The production of byproduct coke was 44,569,121 tons, an increase of 30 percent over 1935; and the production of beehive coke was 1,706,063 tons, an increase of 86 percent over 1935. The leading States, in order of importance in the manufacture of byproduct coke, were Pennsylvania, Ohio, Indiana, New York, and Alabama. The production of each of these States exceeded 3,000,000 tons in 1936, and their combined output equaled 72 percent of the national production. Pennsylvania and West Virginia lead in the production of beehive coke, their combined output having been 85 percent of the total national output.

Byproduct coke produced at plants classified as furnace plants totaled 32,076,089 tons, an increase of 39 percent over 1935, while production at merchant byproduct plants increased only 12 percent. The increase in coke production at furnace plants is a result of the larger output of pig iron, which was 46 percent higher in 1936 than in 1935. Nonfurnace or merchant plants enjoy the greater stability of a diversified coke market, and the changes in production each year are not of the same magnitude as those at furnace plants when there are widely fluctuating demands for pig iron. Nearly 29 percent of the merchant byproduct coke is manufactured at plants owned by city gas companies. The production of coke at gas-company plants is fairly constant each year, and this has a stabilizing effect on the amount of merchant coke produced each year. On the other hand, furnace-coke production tends to vary with pig-iron production. Normally, the production of coke at furnace plants is nearly 80 percent of all byproduct coke made. In 1936, 72 percent of the byproduct coke was manufactured at furnace plants compared with 54 percent in 1932 and 67 percent in 1935. Table 9 shows the fluctuations in monthly production of coke at furnace plants compared with the fairly uniform monthly production at other plants.

Monthly production of coke increased fairly steadily from 3,446,800 tons in January to 4,599,700 tons in December. The monthly output of byproduct coke showed a similar trend. The production of beehive coke declined during the summer months. (See table 4.)

Value and price of coke.—The value of byproduct coke at the ovens was $225,695,719 in 1936, an increase of 30 percent over 1935 values. The value of beehive coke at the ovens was $6,678,272, an increase of 86 percent over 1935. The average value of both byproduct and beehive coke in 1936 remained the same as in 1935, or $5.06 and $3.91 per ton, respectively. The lower cost of coal charged in ovens ($3.82 in 1935 and $3.61 in 1936) is partly reflected in the lack of change in the price for coke. Values and prices for the various grades of beehive and byproduct coke are shown in tables 27, 28, and 33. Average monthly prices (quoted by Steel) remained fairly uniform throughout the year in the 11 markets given in table 35.

Number and capacity of ovens.—At the end of 1936 there were 12,849 byproduct ovens and 13,012 beehive ovens in existence. During the year 210 new byproduct ovens and 1,343 new beehive ovens were completed. In 1936, 40 byproduct ovens and 1,471 beehive ovens were abandoned. The number of beehive ovens has decreased from 60,432 at the end of 1924 to 13,012 at the end of 1936.

Production of byproduct coke in 1936 was 72 percent of the calculated capacity of all byproduct ovens compared with 34 percent in 1932 and 55 in 1935. (See table 16.) If the byproduct coke ovens had been operated at 90 percent capacity, at the end of 1936 their potential output would have been 56,000,000 tons of coke, nearly equaling the 59,883,845 tons of byproduct and beehive coke manufactured in the peak year 1929.

Coal charged in coke ovens.—In 1936, 65,941,675 tons of coal were charged into coke ovens; of this quantity, 63,243,517 tons were used in byproduct ovens and 2,698,158 tons in beehive ovens.

The leading States mining coking coal, in order of importance, are Pennsylvania, West Virginia, and Kentucky. Of the 63,777,942 tons of coal purchased for use at byproduct plants, 57,334,950 tons (90 percent) were mined in these three States.

Coal cleaned mechanically before being charged into byproduct ovens represented 24.3 percent of that charged in 1936 compared with 23.8 percent in 1935.

Consumption of coke.—The indicated consumption of coke in 1936 was 47,032,147 tons compared with 35,613,824 in 1935, iron furnaces using 31,255,648 tons (66 percent). (See table 25.) For data on consumption by uses see tables 27 and 28.

Stocks of coke.—On January 1, 1937 stocks of coke were 1,732,066 tons, 1,097,318 tons less than on January 1, 1936. Stocks of furnace and foundry coke on January 1, 1937, were 421,305 tons lower than on January 1, 1936, and stocks of domestic and other grades were 676,013 tons lower.

Exports and imports.—Exports of coke in 1936 were 670,312 net tons valued at $4,191,135 compared with 613,975 tons valued at $3,590,143 in 1935. Imports were 329,957 tons, an increase of 12,578 tons over 1935, and the value increased from $1,574,578 to $1,635,501.

Gross value and yield of byproducts.—The gross value of all the byproducts recovered in 1936, not including breeze, was $120,205,633. If breeze also is counted as a byproduct, the total value becomes $127,471,248.

The average yield of byproducts per ton of coal charged has increased notably since the Bureau began to keep records of operating performance. (See fig. 62.) During the depression, the calculated average yields were affected by the closing down of certain ovens or plants, but the long-time trend is unmistakably upward. Since 1915 the average yield of tar has increased from 7.1 to 8.86 gallons, and the average quantity of surplus gas available for sale or use has increased from 4,325 to 6,860 cubic feet.

Four of the 85 byproduct plants active in 1936 produced no ammonia during the year. The 81 plants continuing to recover ammonia obtained an average yield of 22.14 pounds of sulphate per ton of coal carbonized. (See table 47.)

Of the 85 plants active in 1936, only 62 recovered light oil. The average yield obtained by these 62 plants was 2.91 gallons per ton. (See table 48.) The production of motor benzol increased from 58,379,910 gallons in 1935 to 85,672,953 in 1936. Naphthalene sold by byproduct coke operators increased from 13,214,108 pounds in 1935 to 34,946,890 in 1936.

Unit values of byproducts.—Gas is the most important byproduct in value, followed by light oil and derivatives, tar, and ammonia in the

order named. (See table 42.) The unit value of the surplus gas sold or used by all plants declined from 18.2 cents per M cubic feet in 1935 to 16.3 cents in 1936. The average for all plants, however, is much affected by the relative activity of the furnace and merchant plants. The latter group, especially the plants affiliated with gas-utility systems, obtain much higher prices for their gas than do the furnace group. A better indication of the trend is given by the average values reported for the two groups, which are as follows:

Year	Furnace plants	Merchant plants	Total	Year	Furnace plants	Merchant plants	Total
	Cents	*Cents*	*Cents*		*Cents*	*Cents*	*Cents*
1929	11.6	30.2	16.6	1935	11.3	28.9	18.2
1933	12.0	29.6	20.3	1936	10.8	27.6	16.3
1934	11.8	28.6	19.1				

The shift in relative activity of furnace and merchant plants also affects the computed gross values of the several byproducts per ton of coke, shown in figure 61.

The unit values of crude light oil and light-oil derivatives generally were higher in 1936 than in 1935. (See table 42.) The unit values of tar increased slightly, while those of ammonia showed little change. However, because of increased production, the total values of all of the principal byproducts were higher in 1936 than in 1935, despite the change in unit prices.

Technical developments.—The reader is referred to the chapter on Recent Developments in Coal Preparation and Utilization for a review of coke technology during 1936. During the past year the Bureau of Mines has issued reports on the carbonization properties of the Clintwood bed in Virginia, the Pittsburgh bed in Pennsylvania, and the Miller's Creek bed in Kentucky.

COKE AND OTHER DOMESTIC FUELS

Coke for domestic heating.—For domestic heating coke offers certain advantages in cleanliness compared with bituminous coal, and in many localities it is cheaper than the prepared sizes of anthracite. The marketing of domestic coke is not a simple merchandising problem because coke has burning characteristics different from those of either anthracite or bituminous coal. Therefore to introduce coke in any market area successfully and to hold customers after sales are made it is necessary to carry on expensive educational campaigns. Figure 59 shows how the total sales of domestic coke have risen since 1921, even in the depression years that followed the boom of the late twenties. Total sales of domestic coke (byproduct and beehive) amounted to 7,511,023 tons in 1929 and the volume of sales increased an average of 750,000 tons each year until 1933, when 10,491,037 tons were sold; in 1934 sales were 10,520,295 tons, an increase of only 29,258 tons over 1933; in 1935 sales dropped to 9,426,386 tons, a decline of 1,093,909 tons (10 percent); and in 1936 sales rose to 10,021,343 tons, an increase of 594,957 tons (6 percent).

A more detailed examination of the trend shows that sales of domestic coke at merchant plants increased from 5,986,373 tons in 1930 to 7,595,108 in 1933, then declined to 7,238,296 tons in 1934,

dropped still further to 7,012,739 tons in 1935, and rose to 7,646,714 tons in 1936. Sales of domestic coke at furnace plants increased each year from 1,900,059 tons in 1930 to 2,935,818 in 1934, but fell to 2,149,241 tons in 1935 and dropped still further to 1,996,793 tons in 1936. The decline in sales of domestic coke at furnace plants in recent years is due largely to the fact that these plants are consuming more of their own product and selling more to other industrial consumers, with the result that less coke reaches the domestic market. The trend in sales of domestic beehive coke has been erratic, being as low as 118,665 tons in 1931 and as high as 346,181 tons in 1934. In 1936 beehive sales amounted to 377,836 tons, an increase of 43 percent over 1935.

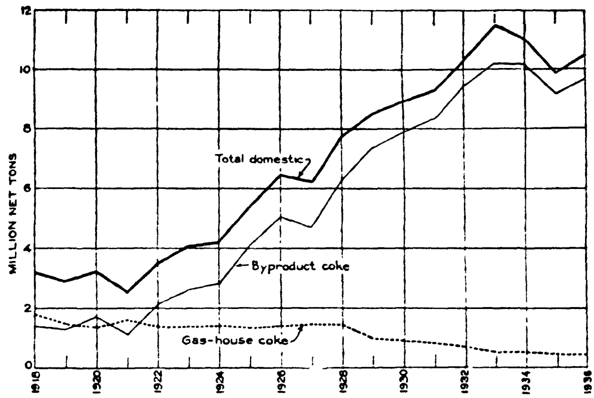


FIGURE 59.—Growth of sales of domestic coke, byproduct coke, and gas-house coke, 1918–36.

Supplies of fuel for domestic purposes.—More domestic coke was sold in 1936 than in 1935. Statistics for all of the other fuels are not available for 1936, but the trend since 1932 indicates increasing domestic consumption of anthracite, oil, and natural gas. (See table 29.)

The introduction of natural gas into the Middle West through long-distance pipe lines has afforded a new competitive fuel in some parts of that area. The amount of natural gas consumed for domestic and commercial heating in the Middle West has been increasing.

COKE AND COKE BREEZE

MONTHLY AND WEEKLY PRODUCTION

TABLE 4.—*Byproduct, beehive, and total coke produced in the United States, 1933–36, by months, and average per day, in net tons*

Month	1933		1934		1935		1936	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
Byproduct:								
January	1,782,700	57,500	2,471,800	79,700	2,796,800	90,200	3,313,500	106,900
February	1,636,600	58,500	2,490,800	89,000	2,777,200	99,200	3,145,600	108,500
March	1,663,000	53,600	2,965,600	95,700	2,937,100	93,800	3,262,100	105,200
April	1,651,900	55,100	2,872,500	95,800	2,666,200	88,800	3,471,400	115,700
May	1,914,900	61,700	3,188,800	102,900	2,789,200	90,000	3,758,800	121,300
June	2,236,600	74,600	2,987,000	99,600	2,595,000	86,500	3,700,300	123,300
July	2,793,200	90,100	2,379,800	76,800	2,562,000	82,600	3,723,200	120,100
August	2,920,200	94,200	2,277,700	73,500	2,773,600	89,400	3,871,400	124,900
September	2,707,900	90,300	2,171,300	72,400	2,832,700	94,400	3,836,800	127,900
October	2,579,000	83,200	2,312,400	74,600	3,048,300	98,300	4,077,200	131,500
November	2,341,100	78,000	2,261,500	75,400	3,112,100	103,700	4,054,400	135,100
December	2,451,000	79,000	2,413,600	77,900	3,363,900	108,500	4,354,400	140,500
	28,678,100	73,100	30,792,800	84,400	34,224,100	93,800	44,569,100	121,700

TABLE 4.—*Byproduct, beehive, and total coke produced in the United States, 1933–36, by months, and average per day, in net tons*—Continued

Month	1933		1934		1935		1936	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
Beehive:								
January	89,100	3,400	111,200	4,100	86,900	3,200	133,300	4,900
February	91,000	3,800	133,400	5,600	90,700	3,800	144,500	5,800
March	100,800	3,700	166,200	6,200	99,200	3,800	103,000	4,000
April	51,500	2,100	73,700	2,900	65,100	2,500	85,200	3,300
May	52,200	1,900	65,500	2,400	54,900	2,000	80,600	3,100
June	55,500	2,100	62,700	2,400	58,600	2,300	87,300	3,400
July	75,800	3,000	52,200	2,100	44,600	1,700	104,200	4,000
August	78,600	2,900	45,400	1,700	54,500	2,000	120,300	4,600
September	66,800	2,600	57,100	2,300	55,500	2,200	153,900	5,900
October	51,000	2,000	77,800	2,900	88,900	3,300	222,700	8,200
November	101,900	3,900	96,800	3,700	99,800	3,800	225,800	9,000
December	96,900	3,900	86,800	3,500	118,500	4,700	245,300	9,400
	911,100	2,900	1,028,800	3,300	917,200	2,900	1,706,100	5,500
Total coke:								
January	1,871,800	60,900	2,583,000	83,800	2,883,700	93,400	3,446,800	111,800
February	1,727,600	62,300	2,624,200	94,600	2,867,900	103,000	3,290,100	114,300
March	1,763,800	57,300	3,131,800	101,900	3,006,300	97,600	3,365,100	109,200
April	1,703,400	57,200	2,946,200	98,700	2,731,300	91,300	3,556,600	119,000
May	1,967,100	63,600	3,254,300	105,300	2,844,100	92,000	3,839,400	124,400
June	2,292,100	76,700	3,049,700	102,000	2,653,600	88,800	3,787,600	126,700
July	2,869,000	93,100	2,432,000	78,900	2,606,600	84,300	3,827,400	124,100
August	2,998,800	97,100	2,323,100	75,200	2,828,100	91,400	3,991,700	129,500
September	2,774,700	92,900	2,228,400	74,700	2,888,200	96,600	3,990,700	133,800
October	2,630,000	85,200	2,390,200	77,500	3,137,200	101,600	4,299,900	139,700
November	2,443,000	81,900	2,358,300	79,100	3,211,900	107,500	4,280,200	144,100
December	2,547,900	82,900	2,500,400	81,400	3,482,400	113,200	4,599,700	149,900
	27,589,200	76,000	31,821,600	87,700	35,141,300	96,700	46,275,200	127,200

TABLE 5.—*Beehive coke produced in the United States in 1936, by weeks*

[Estimated from railroad shipments]

Week ended—	Net tons	Week ended—	Net tons	Week ended—	Net tons
Jan. 1–4 [1]	24,400	May 9	16,800	Sept. 12	32,700
Jan. 11	23,000	May 16	18,300	Sept. 19	37,700
Jan. 18	29,100	May 23	18,900	Sept. 26	36,300
Jan. 25	28,200	May 30	20,600	Oct. 3	39,800
Feb. 1	32,000	June 6	18,200	Oct. 10	50,000
Feb. 8	34,400	June 13	20,800	Oct. 17	51,000
Feb. 15	34,200	June 20	21,500	Oct. 24	54,600
Feb. 22	35,800	June 27	19,600	Oct. 31	47,200
Feb. 29	34,700	July 4	17,000	Nov. 7	60,700
Mar. 7	27,300	July 11	23,200	Nov. 14	50,100
Mar. 14	24,300	July 18	23,900	Nov. 21	49,000
Mar. 21	20,200	July 25	23,600	Nov. 28	56,200
Mar. 28	23,500	Aug. 1	28,400	Dec. 5	58,600
Apr. 4	23,100	Aug. 8	25,600	Dec. 12	54,500
Apr. 11	20,800	Aug. 15	28,200	Dec. 19	59,500
Apr. 18	19,800	Aug. 22	27,500	Dec. 26	47,600
Apr. 25	17,200	Aug. 29	28,800	Dec. 28–31 [1]	37,000
May 2	18,000	Sept. 5	32,700		1,706,100

[1] 4 days only.

TABLE 6.—*Byproduct coke produced in the United States in 1936, by months and States, in net tons*

[Based on reports from all producers]

State	January	February	March	April	May	June	July
Alabama	247, 100	234, 100	249, 200	232, 500	255, 500	244, 700	252, 700
Colorado	17, 200	24, 300	34, 700	44, 600	35, 200	30, 300	19, 600
Illinois	167, 300	157, 800	167, 900	161, 300	162, 000	155, 400	165, 600
Indiana	372, 600	350, 100	386, 800	425, 700	467, 500	475, 200	491, 400
Maryland	91, 700	87, 400	94, 300	90, 800	111, 000	94, 500	82, 500
Massachusetts	96, 600	81, 100	91, 400	103, 400	90, 700	80, 100	79, 200
Michigan	200, 700	185, 800	198, 500	194, 700	200, 900	190, 500	193, 100
Minnesota	41, 500	40, 600	40, 400	35, 000	36, 800	39, 400	39, 400
New Jersey	87, 800	80, 800	87, 900	70, 700	87, 800	82, 600	83, 600
New York	384, 800	372, 300	380, 300	387, 800	413, 200	419, 000	412, 900
Ohio	466, 300	484, 200	502, 300	512, 500	510, 200	486, 400	505, 100
Pennsylvania	825, 400	765, 400	755, 300	916, 800	1, 064, 300	1, 089, 000	1, 073, 600
Tennessee	7, 400	7, 600	7, 000	6, 800	7, 100	6, 300	6, 600
Utah	10, 100	10, 600	10, 400	9, 900	10, 000	9, 500	9, 500
Washington	2, 500	2, 700	2, 400	2, 400	2, 300	2, 300	2, 400
West Virginia	145, 000	112, 600	108, 100	127, 500	146, 600	138, 800	143, 800
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	149, 500	148, 200	145, 200	149, 000	157, 700	156, 300	162, 200
Total production	3, 313, 500	3, 145, 600	3, 262, 100	3, 471, 400	3, 758, 800	3, 700, 300	3, 723, 200
At merchant plants	1, 019, 100	972, 300	1, 011, 400	988, 200	1, 034, 200	1, 003, 000	1, 020, 200
At furnace plants	2, 294, 400	2, 173, 300	2, 250, 700	2, 483, 200	2, 724, 600	2, 697, 300	2, 703, 000

State	August	September	October	November	December	Total
Alabama	254, 400	254, 700	269, 900	273, 900	320, 900	3, 089, 600
Colorado	25, 500	25, 600	22, 400	23, 200	34, 700	337, 300
Illinois	175, 200	179, 000	192, 200	193, 300	205, 500	2, 082, 500
Indiana	479, 800	464, 100	497, 800	488, 900	549, 900	5, 449, 800
Maryland	99, 700	111, 600	118, 600	114, 600	120, 400	1, 217, 000
Massachusetts	84, 300	92, 300	101, 200	102, 900	105, 000	1, 108, 200
Michigan	189, 800	179, 100	186, 100	183, 200	191, 300	2, 293, 700
Minnesota	38, 400	41, 400	44, 100	59, 200	65, 300	521, 500
New Jersey	83, 700	83, 500	87, 400	84, 300	87, 400	1, 007, 500
New York	408, 400	400, 400	414, 500	409, 100	433, 200	4, 835, 900
Ohio	535, 900	524, 200	554, 200	568, 100	592, 900	6, 242, 300
Pennsylvania	1, 160, 700	1, 151, 800	1, 245, 200	1, 220, 600	1, 302, 700	12, 570, 800
Tennessee	6, 900	6, 900	6, 900	6, 700	7, 100	83, 300
Utah	11, 000	10, 400	12, 000	9, 700	11, 200	124, 300
Washington	2, 500	2, 300	2, 400	2, 000	2, 200	28, 400
West Virginia	154, 500	153, 300	158, 600	154, 900	159, 100	1, 702, 800
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	160, 700	156, 200	163, 700	159, 900	165, 600	1, 874, 200
Total production	3, 871, 400	3, 836, 800	4, 077, 200	4, 054, 400	4, 354, 400	44, 569, 100
At merchant plants	1, 044, 300	1, 041, 500	1, 101, 100	1, 095, 500	1, 162, 200	12, 493, 000
At furnace plants	2, 827, 100	2, 795, 300	2, 976, 100	2, 958, 900	3, 192, 200	32, 076, 100

TABLE 7.—*Beehive coke produced in the United States in 1936, by months and States, in net tons*

[Based on railroad shipments]

State	January	February	March	April	May	June	July
Colorado	7, 700	6, 300	6, 200	5, 200	3, 800	4, 200	2, 400
Pennsylvania	91, 600	103, 800	63, 700	48, 100	42, 100	44, 600	64, 000
Tennessee	100	200	100	100	100	100	100
Utah	500	600	700	600	100	100	500
Virginia	15, 100	14, 800	12, 700	13, 600	16, 400	20, 900	19, 800
Washington	100	200	------	------	------	------	------
West Virginia	18, 200	18, 600	19, 600	17, 600	18, 100	17, 400	17, 400
	133, 300	144, 500	103, 000	85, 200	80, 600	87, 300	104, 200

TABLE 7.—*Beehive coke produced in the United States in 1936, by months and States, in net tons*—Continued

State	August	September	October	November	December	Total
Colorado	2,600	4,100	5,900	6,000	6,900	61,300
Pennsylvania	82,300	112,700	175,200	184,300	200,900	1,213,300
Tennessee	800	400	400	500	700	3,600
Utah	300	700	800	500	200	5,600
Virginia	18,400	17,300	17,400	12,000	12,900	191,300
Washington						300
West Virginia	15,900	18,700	23,000	22,500	23,700	230,700
	120,300	153,900	222,700	225,800	245,300	1,706,100

PRODUCTION BY FURNACE AND NONFURNACE PLANTS

TABLE 8.—*Number and production of byproduct coke plants connected with iron furnaces and of other byproduct plants, 1913, 1918, and 1934–36*

Year	Number of active plants		Coke produced (net tons)		Percent of production	
	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other plants
1913	20	16	9,277,832	3,436,868	73.0	27.0
1918	36	24	19,220,342	6,777,238	73.9	26.1
1934	41	42	19,241,850	11,550,961	62.5	37.5
1935	40	41	23,034,261	11,189,792	67.3	32.7
1936	42	43	32,076,089	12,493,032	72.0	28.0

TABLE 9.—*Monthly and average daily production of byproduct coke by plants associated with iron furnaces and by all other plants, 1934–36, in net tons*

Month	1934		1935		1936	
	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other plants
Monthly production:						
January	1,536,900	934,900	1,825,400	971,400	2,294,400	1,019,100
February	1,583,000	907,800	1,898,400	878,800	2,173,300	972,300
March	1,945,100	1,020,500	1,944,400	962,700	2,250,700	1,011,400
April	1,923,600	948,900	1,764,800	901,400	2,483,200	988,200
May	2,202,300	986,500	1,856,700	932,500	2,724,600	1,034,200
June	2,032,800	954,200	1,703,400	891,600	2,697,300	1,003,000
July	1,432,900	946,900	1,678,000	884,000	2,703,000	1,020,200
August	1,343,700	934,000	1,870,100	903,500	2,827,100	1,044,300
September	1,242,000	929,300	1,923,700	909,000	2,795,300	1,041,500
October	1,318,900	993,500	2,075,400	972,900	2,976,100	1,101,100
November	1,269,400	992,100	2,144,700	967,400	2,958,900	1,095,500
December	1,411,200	1,002,400	2,349,300	1,014,600	3,192,200	1,162,200
	19,241,800	11,551,000	23,034,300	11,189,800	32,076,100	12,493,000
Average daily production:						
January	49,600	30,100	58,900	31,300	74,000	32,900
February	56,600	32,400	67,800	31,400	75,000	33,500
March	62,800	32,900	62,700	31,100	72,600	32,600
April	64,100	31,700	58,800	30,000	82,800	32,900
May	71,100	31,800	59,900	30,100	87,900	33,400
June	67,800	31,800	56,800	29,700	89,900	33,400
July	46,200	30,600	54,100	28,500	87,200	32,900
August	43,400	30,100	60,300	29,100	91,200	33,700
September	41,400	31,000	64,100	30,300	93,200	34,700
October	42,500	32,100	66,900	31,400	96,000	35,500
November	42,300	33,100	71,500	32,200	98,600	36,500
December	45,500	32,400	75,800	32,700	103,000	37,500
Average	52,700	31,700	63,100	30,700	87,600	34,100

PRODUCTION BY STATES AND DISTRICTS

TABLE 10.—*Byproduct and beehive coke produced, by States, 1918 and 1933–36, in net tons*

State	1918	1933	1934	1935	1936
Byproduct:					
Alabama	2,634,451	1,668,975	2,109,192	1,994,220	3,089,622
Colorado	230,663	139,722	171,104	206,901	337,341
Connecticut		(1)	(1)	(1)	(1)
Illinois	2,285,610	1,501,020	1,649,907	1,668,523	2,082,516
Indiana	3,898,215	2,089,100	2,613,437	3,768,480	5,449,755
Kentucky	517,749	(1)	(1)	(1)	(1)
Maryland	474,368	702,227	784,539	929,617	1,217,039
Massachusetts	556,397	1,020,255	1,127,632	1,006,115	1,108,219
Michigan	(1)	2,341,081	2,547,747	2,482,302	2,293,653
Minnesota	784,065	412,037	417,447	430,082	521,518
Missouri	(1)	(1)	(1)	(1)	(1)
New Jersey	682,148	835,125	910,121	917,117	1,007,500
New York	1,069,587	3,426,529	4,089,708	4,099,242	4,835,921
Ohio	5,226,334	3,676,727	4,296,338	5,100,987	6,242,300
Pennsylvania	4,586,981	6,170,240	6,834,362	8,078,175	12,570,816
Rhode Island		(1)	(1)	(1)	(1)
Tennessee	124,469	71,484	70,598	78,668	83,305
Utah		66,945	117,401	115,282	124,346
Washington	30,129	31,817	27,199	28,744	28,368
West Virginia	603,393	1,074,002	1,343,914	1,603,584	1,702,792
Wisconsin	(1)	(1)	(1)	(1)	(1)
Combined States	2,293,021	1,450,850	1,682,165	1,716,014	1,874,110
	25,997,580	26,678,136	30,792,811	34,224,053	44,569,121
Beehive:					
Alabama	1,717,721				
Colorado	758,784	35,161	37,804	49,209	61,293
Georgia	22,048				
Kentucky	301,036				
New Mexico	597,072				
Ohio	138,909				
Oklahoma	(1)				
Pennsylvania	22,136,664	670,179	720,593	564,052	1,213,294
Tennessee	302,637	11,807	5,993	3,099	3,567
Utah	(1)	10,156	13,203	5,575	5,617
Virginia	1,234,256	70,493	77,960	137,587	191,331
Washington	93,659	379	1,694	2,475	312
West Virginia	2,716,613	112,883	171,518	155,211	230,649
Combined States	461,393				
	30,480,792	911,058	1,028,765	917,208	1,706,063
Grand total	56,478,372	27,589,194	31,821,576	35,141,261	46,275,184

[1] Included under "Combined States."

TABLE 11.—*Byproduct and beehive coke produced in Pennsylvania in 1936, by districts*

[Number of plants and ovens includes those idle during the year; no new ovens were under construction in 1936]

District	Plants	Ovens	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens	
						Total	Per ton
Byproduct:							
Eastern Pennsylvania [1]	5	734	2,713,890	70.18	1,904,578	$11,168,588	$5.86
Western Pennsylvania [2]	7	2,614	15,666,274	68.08	10,666,238	38,475,847	3.61
	12	3,348	18,380,164	68.39	12,570,816	49,644,435	3.95
Beehive:							
Allegheny Mountain and Allegheny Valley	3	434	77,041	55.66	42,879	190,384	4.44
Connellsville	18	3,883	371,788	66.45	247,059	953,942	3.86
Lower Connellsville	17	2,791	897,143	65.08	583,846	2,090,341	3.58
Upper Connellsville	5	670	164,821	68.44	112,810	443,852	3.93
Pittsburgh	2	491					
Other districts [3]	4	767	368,394	61.53	226,700	886,505	3.91
	49	9,036	1,879,187	64.56	1,213,294	4,565,024	3.76
Grand total	61	12,384	20,259,351	68.04	13,784,110	54,209,459	3.93

[1] Includes plants at Bethlehem, Chester, Philadelphia, Steelton, and Swedeland.
[2] Includes plants at Aliquippa, Clairton, Erie, Johnstown, Midland, Neville Island, and Pittsburgh.
[3] Includes Bedford and parts of Indiana and Westmoreland Counties.

TABLE 12.—*Byproduct coke produced in Ohio in 1936, by districts*

District	Plants	Ovens	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens	
						Total	Per ton
Canton, Cleveland, and Massillon	5	595	2,459,628	69.69	1,714,087	$7,159,777	$4.18
Youngstown	3	594	2,454,928	69.80	1,713,527	6,919,528	4.04
Other districts [1]	7	650	3,846,152	73.18	2,814,686	12,858,702	4.57
Total, 1936	15	1,839	8,760,708	71.25	6,242,300	26,938,007	4.32
Total, 1935	15	1,834	7,202,127	70.83	5,100,987	23,088,113	4.53
Change in 1936 .... percent		+0.3	+21.6	+0.6	+22.4	+16.7	−4.6

[1] Includes plants at Hamilton, Ironton, Lorain, Painesville, Portsmouth, Toledo, and Warren.

NUMBER AND TYPE OF OVENS

TABLE 13.—*Coke ovens completed and abandoned in 1936 and total number in existence at end of year, by States*

State	Plants in existence Dec. 31	Ovens						
		In existence Dec. 31		New		Abandoned during year	Under construction Dec. 31	
		Number	Capacity per day (net tons of coke)	Number	Capacity per day (net tons of coke)		Number	Capacity per day (net tons of coke)
Byproduct:								
Alabama	8	1,248	14,305				146	2,220
Colorado	1	151	2,233					
Connecticut	1	61	(1)					
Illinois	8	896	12,634	16	200	40		
Indiana	6	1,548	20,779	[2] 138	[2] 2,065			
Kentucky	1	108	(1)				12	(1)
Maryland	1	361	5,088					
Massachusetts	3	430	4,483					
Michigan	9	614	6,391				122	2,900
Minnesota	3	196	2,572					
Missouri	1	64	(1)					
New Jersey	2	239	2,750					
New York	9	1,024	15,324					
Ohio	15	1,839	24,957	[2] 23	[2] 276			
Pennsylvania	12	3,348	45,939					
Rhode Island	1	65	(1)					
Tennessee	1	24	350					
Utah	1	56	705	[2] 33	[2] 414			
Washington	1	20	108					
West Virginia	4	362	5,088				25	(1)
Wisconsin	2	195	(1)					
Undistributed			6,364					554
Total byproduct	90	12,849	170,070	210	2,955	40	305	5,674
At merchant plants	45	3,675	44,431	16	200		37	554
At furnace plants	45	9,174	125,639	194	2,755	40	268	5,120
Beehive:								
Colorado	2	188				190		
Pennsylvania	49	9,036		[2] 1,120	(3)	973	[2] 27	(3)
Tennessee	2	161				60		
Utah	1	819						
Virginia	7	1,291	(3)	[2] 19	(3)			
Washington	1	58						
West Virginia	9	1,459		[2] 204	(3)	248		
Total beehive	71	13,012		1,343	(3)	1,471	27	(3)

[1] Included under "Undistributed."
[2] New ovens replacing old ovens that were rebuilt.
[3] Data not available.

TABLE 14.—*Byproduct ovens of each type at end of 1936, by States*

State	Koppers[1]	Semet-Solvay	Wilputte	United Otto	Cambria-Belgian	Roberts	American Foundation	Klönne	All others[2]	Total
Alabama	768	420	60							1,248
Colorado	151									151
Connecticut	61									61
Illinois	662	120	88						26	896
Indiana	1,127	161	260							1,548
Kentucky		108								108
Maryland	361									361
Massachusetts	175		55	200						430
Michigan	131	276	120						87	614
Minnesota	196									196
Missouri	56								8	64
New Jersey	239									239
New York	743	226					55			1,024
Ohio	1,546	293								1,839
Pennsylvania	3,018	88	97		120	25				3,348
Rhode Island	65									65
Tennessee		24								24
Utah	56									56
Washington								20		20
West Virginia	316		46							362
Wisconsin	115	80								195
Total	9,786	1,796	726	200	120	25	55	20	121	12,849
At merchant plants	1,953	1,080	221	200		25	55	20	121	3,675
At furnace plants	7,833	716	505		120					9,174

[1] Includes the Koppers-Becker type.
[2] Includes 26 Curran-Knowles, 27 Parker-Russell, 60 Improved Equipment Co., and 8 Piette ovens.

CAPACITY OF BYPRODUCT OVENS

TABLE 15.—*Estimated annual potential production of coke and coal required for charge of byproduct coke ovens in the United States, 1934–36, when operated at different percentages of maximum capacity, in millions of net tons*

Percent of maximum capacity	1934		1935		1936			
	Ovens completed Dec. 31[1]				Ovens completed Dec. 31		Including ovens under construction	
	Coke	Coal[2]	Coke	Coal[2]	Coke	Coal[2]	Coke	Coal[2]
100	62.8	89.7	62.4	89.1	62.2	88.9	64.3	91.9
90	56.5	80.7	56.2	80.2	56.0	80.0	57.9	82.7
85	53.4	76.2	53.0	75.7	52.9	75.6	54.7	78.1
75	47.1	67.3	46.8	66.8	46.7	66.7	48.2	68.9
50	31.4	44.9	31.2	44.6	31.1	44.5	32.2	46.0

[1] No ovens under construction at end of 1935.
[2] Coal for charge estimated on basis of 70 percent yield in coke.

TABLE 16.—*Relation (percent) of production to maximum capacity at byproduct coke plants, 1929 and 1932–36, by months*

Month	1929	1932	1933	1934	1935	1936	Month	1929	1932	1933	1934	1935	1936
January	88.6	39.0	33.6	46.6	52.5	62.4	August	93.6	27.4	55.0	42.8	52.1	74.2
February	91.3	39.6	34.1	52.0	57.7	63.3	September	91.9	29.7	52.7	42.1	55.0	76.0
March	93.0	38.8	31.3	55.9	54.6	61.5	October	92.3	32.3	48.6	43.5	57.2	78.1
April	92.8	36.2	32.2	56.0	51.7	67.6	November	89.0	33.6	45.6	43.9	60.3	80.3
May	94.0	32.4	36.1	60.1	52.4	70.8	December	83.1	33.2	46.2	45.3	63.1	83.4
June	93.9	29.5	43.5	58.2	50.4	72.1							
July	93.0	28.3	52.6	44.7	48.2	71.5	The year	91.4	33.6	42.7	49.2	54.6	71.6

QUANTITY AND COST OF COAL CHARGED

TABLE 17.—*Coal consumed in coke ovens, 1934–36, by months, in net tons*

[For figures, 1912–30, inclusive, see Coke and Byproducts in 1928, pp. 731–733, and Coke and Byproducts in 1930, p. 514]

Month	1934			1935			1936		
	Byproduct	Beehive	Total	Byproduct	Beehive	Total	Byproduct	Beehive	Total
January	3,574,000	177,000	3,751,000	4,022,600	138,700	4,161,300	4,710,400	209,900	4,920,300
February	3,597,200	211,800	3,809,000	3,993,400	146,300	4,139,700	4,470,100	227,600	4,697,700
March	4,284,700	264,700	4,549,400	4,181,200	159,900	4,341,100	4,634,500	162,300	4,796,800
April	4,155,600	117,400	4,273,000	3,828,100	104,800	3,932,900	4,935,800	134,100	5,069,900
May	4,615,100	103,600	4,718,700	4,007,600	89,700	4,097,300	5,346,100	126,900	5,473,000
June	4,321,500	100,300	4,421,800	3,730,300	95,400	3,825,700	5,263,900	137,600	5,401,500
July	3,403,100	83,200	3,486,300	3,660,000	71,800	3,731,800	5,271,100	165,200	5,436,300
August	3,262,400	71,700	3,334,100	3,961,500	87,600	4,049,100	5,484,200	190,700	5,674,900
September	3,112,300	89,900	3,202,200	4,047,100	87,900	4,135,000	5,435,700	244,000	5,679,700
October	3,315,400	124,500	3,439,900	4,357,300	140,600	4,497,900	5,777,100	353,100	6,130,200
November	3,244,400	154,300	3,398,700	4,448,800	157,700	4,606,500	5,744,300	357,900	6,102,200
December	3,457,300	136,900	3,594,200	4,807,700	188,500	4,996,200	6,170,300	388,900	6,559,200
	44,343,000	1,635,300	45,978,300	49,045,600	1,468,900	50,514,500	63,243,500	2,698,200	65,941,700

TABLE 18.—*Total quantity and value at ovens of coal used in manufacture of coke, by States, in 1936*

State	Coal used (net tons)	Cost of coal		Coal per ton of coke	
		Total	Per ton of coal	Net tons	Cost
Byproduct plants:					
Alabama	4,435,328	$9,918,564	$2.24	1.44	$3.23
Colorado	505,908	(1)	(1)	1.50	(1)
Illinois	3,034,695	13,445,577	4.43	1.46	6.47
Indiana	7,410,152	34,090,501	4.60	1.36	6.26
Maryland	1,683,792	(1)	(1)	1.38	(1)
Massachusetts	1,566,576	7,794,852	4.98	1.41	7.02
Michigan	3,189,588	13,662,037	4.28	1.39	5.95
Minnesota	753,396	3,980,305	5.28	1.44	7.60
New Jersey	1,417,502	(1)	(1)	1.41	(1)
New York	6,730,448	29,966,997	4.45	1.39	6.19
Ohio	8,760,708	31,540,626	3.60	1.40	5.04
Pennsylvania	18,380,164	53,964,466	2.94	1.46	4.29
Tennessee	120,816	404,444	3.35	1.45	4.86
Utah	218,594	(1)	(1)	1.76	(1)
Washington	46,983	225,912	4.81	1.66	7.98
West Virginia	2,425,957	5,756,902	2.37	1.42	3.37
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	2,562,910	11,413,477	4.45	1.37	6.10
Undistributed		17,059,645	4.46		
Total byproduct	63,243,517	233,224,305	3.69	1.42	5.24
At merchant plants	17,373,763	77,791,824	4.48	1.39	6.23
At furnace plants	45,869,754	155,432,481	3.39	1.43	4.85
Beehive plants:					
Colorado and Utah	103,695	303,925	2.93	1.55	4.54
Pennsylvania	1,879,187	3,481,541	1.85	1.55	2.87
Tennessee	6,886	11,706	1.70	1.93	3.28
Virginia	330,130	599,515	1.82	1.73	3.15
Washington	501	1,752	3.50	1.61	5.64
West Virginia	377,759	622,488	1.65	1.64	2.71
Total beehive	2,698,158	5,020,927	1.86	1.58	2.94

[1] Included under "Undistributed."

TABLE 19.—*Average cost per net ton of coal charged into byproduct coke ovens, by States, 1929 and 1933–36*

State	1929	1933	1934	1935	1936
Alabama	$2.49	$1.81	$2.28	$2.37	$2.24
Illinois	4.29	4.02	4.49	4.62	4.43
Indiana	4.61	4.19	4.48	4.66	4.60
Massachusetts	4.70	4.34	4.81	5.02	4.98
Michigan	4.29	3.67	4.13	4.28	4.28
Minnesota	5.04	4.69	[1]	[1]	5.28
New York	4.22	4.00	4.35	4.57	4.45
Ohio	3.31	3.10	3.49	3.66	3.60
Pennsylvania	$2.73	$2.84	$3.04	$2.98	$2.94
Tennessee	3.02	2.92	3.18	3.73	3.35
Washington	5.26	4.51	4.60	4.75	4.81
West Virginia	2.41	1.78	2.07	2.20	2.37
United States average	3.50	3.38	3.70	3.82	3.69
Cost of coal per ton of coke	5.04	4.90	5.33	5.46	5.24

[1] Not at liberty to publish data.

PREPARATION AND SOURCE OF COAL CHARGED

TABLE 20.—*Washed and unwashed coal used in the manufacture of byproduct and beehive coke, by States in which used, in 1936, in net tons*

State	Washed	Unwashed	Total
Byproduct ovens:			
Alabama	4,409,017	26,311	4,435,328
Colorado	505,908		505,908
Illinois	449,022	2,585,673	3,034,695
Indiana	11,858	7,398,294	7,410,152
Maryland		1,683,792	1,683,792
Massachusetts	34,211	1,532,365	1,566,576
Michigan		3,189,588	3,189,588
Minnesota		753,396	753,396
New Jersey		1,417,502	1,417,502
New York	1,265,945	5,464,503	6,730,448
Ohio	1,000,684	7,760,024	8,760,708
Pennsylvania	7,473,990	10,906,174	18,380,164
Tennessee	120,816		120,816
Utah		218,594	218,594
Washington	46,983		46,983
West Virginia		2,425,957	2,425,957
Connecticut, Kentucky, Missouri, Rhode Island and Wisconsin	23,209	2,539,701	2,562,910
Total byproduct	15,341,643	47,901,874	63,243,517
At merchant plants	1,744,232	15,629,531	17,373,763
At furnace plants	13,597,411	32,272,343	45,869,754
Beehive ovens:			
Colorado	93,941		93,941
Pennsylvania	585,908	1,293,279	1,879,187
Tennessee	6,886		6,886
Utah		9,754	9,754
Virginia		330,130	330,130
Washington	501		501
West Virginia		377,759	377,759
Total beehive		2,010,922	2,698,158

TABLE 21.—*Coal used in manufacture of byproduct coke in 1936, by fields of origin, in net tons*

[Based upon detailed reports from each coke plant. The difference between these totals and those shown in tables 3, 19, etc., is due to change in stock, loss of weight in handling, and the fact that these sometimes represent purchases during the year rather than actual consumption]

State and district where coal was produced	Total used	States where coal was consumed—in order of importance
Alabama	4,460,630	Alabama and Tennessee.
Colorado:		
Trinidad	410,276	Colorado.
Walsen	46,349	Do.
Crested Butte	45,420	Do.
Canon	3,863	Do.
Illinois: Franklin County	90,964	Illinois.
Kentucky:		
Eastern Kentucky:		
Elkhorn	1,977,957	Indiana, Michigan, New York, Kentucky, Missouri, New Jersey, Minnesota, Ohio, Illinois, and Wisconsin.
Harlan	3,537,860	Indiana, Illinois, Michigan, Ohio, and Minnesota.
Kenova-Thacker [1]	1,233,550	Michigan, Ohio, Wisconsin, Minnesota, Massachusetts, and Illinois.
Miscellaneous Eastern Kentucky	464,432	Indiana.
Pennsylvania:		
Central Pennsylvania, high-volatile	9,814	New York.
Central Pennsylvania, medium-volatile.	600,920	New York and Pennsylvania.
Central Pennsylvania, low-volatile	1,253,509	Pennsylvania, New York, and West Virginia.
Connellsville	13,591,861	Pennsylvania, Ohio, West Virginia, New York, Illinois, Minnesota, Michigan, and Indiana.
Freeport	1,668,909	West Virginia, Michigan, Ohio, New York, and Indiana.
Pittsburgh	9,714,685	Pennsylvania, New York, Ohio, Minnesota, Illinois Massachusetts, Michigan, West Virginia, and Wisconsin.
Somerset	364,234	Pennsylvania and West Virginia.
Westmoreland	895,406	Pennsylvania, Maryland, and New York.
Tennessee	87,915	Tennessee.
Utah: Carbon County	218,594	Utah.
Virginia: [1 2]		
Southwestern Virginia	237,493	New Jersey, New York, Massachusetts, and Pennsylvania.
Washington: Pierce County	47,129	Washington.
West Virginia: [2]		
Northern	2,470,451	Pennsylvania, Maryland, Ohio, and West Virginia.
Kanawha and Logan (including Coal River).	7,961,107	New York, Illinois, Massachusetts, New Jersey, Ohio, Indiana, Michigan, Pennsylvania, Connecticut, Wisconsin, West Virginia, Rhode Island, Kentucky, Minnesota, and Missouri.
New River and Winding Gulf	1,878,355	New York, Massachusetts, New Jersey, Illinois, Rhode Island, Missouri, Kentucky, Minnesota, Indiana, Michigan, and Pennsylvania.
Pocahontas [2]	10,076,552	Indiana, Ohio, New York, Michigan, Illinois, Maryland, Wisconsin, Pennsylvania, Minnesota, West Virginia, Connecticut, Massachusetts, Kentucky, Alabama, and Tennessee.
Coal and Coke	112,904	Pennsylvania.
Webster County	316,803	Pennsylvania and Massachusetts.
	63,777,942	

[1] Tonnage from the Grundy field, Buchanan County, Va., is included under Kenova-Thacker (Kentucky).
[2] Coal from the extension of the Pocahontas field in Tazewell County, Va., is included under West Virginia (Pocahontas).

Table 22.—*Source of coal used in the manufacture of byproduct coke in 1936, by States where consumed, separating merchant and furnace plants*

State where coal was used	Coal produced in—										Total
	Alabama	Colorado	Illinois	Kentucky	Pennsylvania	Tennessee	Utah	Virginia	Washington	West Virginia	
Alabama:											
Merchant plants	644, 671									92, 805	737, 476
Furnace plants	3, 809, 038									7, 765	3, 816, 803
Total	4, 453, 709									100, 570	4, 554, 279
Colorado: Furnace plants		505, 908									505, 908
Illinois:											
Merchant plants			90, 964	94, 414	108, 857					1, 500, 132	1, 794, 367
Furnace plants				565, 669	327, 376					361, 489	1, 254, 534
Total			90, 964	660, 083	436, 233					1, 861, 621	3, 048, 901
Indiana:											
Merchant plants										733, 574	733, 574
Furnace plants				3, 228, 645	121, 149			320, 505		3, 037, 850	6, 708, 149
Total				3, 228, 645	121, 149			320, 505		3, 771, 424	7, 441, 723
Maryland: Furnace plants					331, 663					1, 352, 129	1, 683, 792
Massachusetts: Merchant plants					34, 457			17, 226		1, 513, 558	1, 565, 241
Michigan:											
Merchant plants				501, 071	410, 151			(1)		1, 015, 641	[2] 1, 926, 863
Furnace plants				857, 826						256, 234	1, 114, 060
Total				1, 358, 897	410, 151			(1)		1, 271, 875	[2] 3, 040, 923
Minnesota:											
Merchant plants				72, 145	110, 406					273, 871	456, 422
Furnace plants				239, 606	130, 079					125, 883	495, 568
Total				311, 751	240, 485					399, 754	951, 990
New Jersey: Merchant plants				72, 509				127, 424		1, 222, 698	1, 422, 631

[1] Included under "Undistributed."

[2] Excludes items included under "Undistributed."

TABLE 22.—*Source of coal used in the manufacture of byproduct coke in 1936, by States where consumed, separating merchant and furnace plants*—Continued

State where coal was used	Coal produced in—										Total
	Alabama	Colorado	Illinois	Kentucky	Pennsylvania	Tennessee	Utah	Virginia	Washington	West Virginia	
New York:											
Merchant plants				199,136	1,850,858			97,895		1,650,532	3,798,421
Furnace plants					2,051,647					941,673	2,993,320
Total				199,136	3,902,505			97,895		2,592,205	6,791,741
Ohio:											
Merchant plants								(1)		515,546	[2] 515,546
Furnace plants				443,683	4,567,564					3,008,989	8,020,236
Total				443,683	4,567,564			(1)		3,524,535	[2] 8,535,782
Pennsylvania:											
Merchant plants					40,500			(1)		722,302	[2] 762,802
Furnace plants					16,288,320					1,325,244	17,613,564
Total					16,328,820			(1)		2,047,546	[2] 18,376,366
Tennessee: Merchant plants	6,921					87,915		26,945			121,781
Utah: Furnace plants							218,594				218,594
Washington: Merchant plants									47,129		47,129
West Virginia:											
Merchant plants					20,800					610,086	630,886
Furnace plants					1,682,302					115,416	1,797,718
Total					1,703,102					725,502	2,428,604
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin: Merchant plants				490,940	23,209					2,086,551	2,600,700
Undistributed: Merchant plants								441,857			441,857
Grand total	4,460,630	505,908	90,964	6,765,644	28,099,338	87,915	218,594	1,031,852	47,129	22,469,968	63,777,942
Merchant plants	651,592		90,964	1,430,215	2,599,238	87,915		711,347	47,129	11,937,296	17,555,696
Furnace plants	3,809,038	505,908		5,335,429	25,500,100		218,594	320,505		10,532,672	46,222,246

[1] Included under "Undistributed."

[2] Excludes items included under "Undistributed."

YIELD OF COKE PER TON OF COAL

TABLE 23.—*Percentage yield of coke from coal in byproduct and beehive ovens, by States, 1933–36*

State	1933		1934		1935		1936	
	Byproduct	Beehive	Byproduct	Beehive	Byproduct	Beehive	Byproduct	Beehive
Alabama	68.94		69.73		68.91		69.66	
Colorado	66.28	64.54	66.21	65.17	68.22	64.91	66.68	65.25
Illinois	66.93		67.46		67.30		68.62	
Indiana	70.93		71.42		71.97		73.54	
Maryland	72.25		71.30		72.43		72.28	
Massachusetts	68.80		71.21		70.31		70.74	
Michigan	69.97		70.56		70.56		71.91	
Minnesota	68.18		68.46		68.29		69.22	
New Jersey	70.26		70.29		71.35		71.08	
New York	69.06		69.76		70.08		71.85	
Ohio	70.33		70.42		70.83		71.25	
Pennsylvania	67.21	63.68	67.78	64.08	67.84	63.99	68.39	64.56
Tennessee	70.91	47.42	69.91	47.94	69.31	51.25	68.95	51.80
Utah	53.94	46.34	60.47	52.49	59.78	47.21	56.88	57.59
Virginia		58.22		59.39		58.63		57.96
Washington	56.00	60.93	54.37	63.07	60.78	62.22	60.38	62.28
West Virginia	67.96	60.77	67.79	61.00	69.89	60.85	70.19	61.06
United States average	68.97	62.35	69.44	62.90	69.78	62.44	70.47	63.23

COKE BREEZE

TABLE 24.—*Coke breeze recovered at coke plants in 1936, by States*

State	Yield per ton of coal (percent)	Produced		Used by producer: For steam raising		Used by producer: For other purposes, including water gas		Sold		Wasted (net tons)	On hand Dec. 31 (net tons)
		Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value		
Byproduct ovens:											
Alabama	5.80	257,308	$360,069	131,566	$173,114	7,472	$12,047	91,170	$142,443	6,237	47,098
Colorado	5.47	26,677	(1)	11,771	(1)	------	------	11,318	(1)	------	------
Illinois	6.92	209,908	501,210	140,734	358,182	2,801	3,929	52,696	112,049	------	58,055
Indiana	5.00	370,476	880,509	222,088	486,540	121,352	287,931	32,373	122,673	------	22,020
Maryland	6.64	111,877	(1)	78,697	(1)	19,141	(1)	20,308	(1)	------	6,335
Massachusetts	7.92	124,074	222,964	81,264	123,318	6,159	14,478	40,740	93,225	------	512
Michigan	5.65	180,096	619,272	107,401	444,914	------	------	71,878	145,317	------	2,173
Minnesota	7.11	53,541	165,966	28,673	79,098	15	53	23,579	80,143	------	13,445
New Jersey	6.05	85,726	(1)	102,085	(1)	------	------	8,159	(1)	------	5,879
New York	4.60	309,458	757,317	171,822	399,112	60,873	170,693	107,824	250,146	------	57,394
Ohio	5.06	443,653	830,023	351,629	661,920	67,808	129,141	89,835	152,946	2,769	23,591
Pennsylvania	5.83	1,070,828	1,668,804	914,797	1,451,034	48,767	67,065	85,521	121,638	------	40,160
Tennessee	5.31	6,418	9,627	5,353	8,030	------	------	------	------	------	2,288
Utah	7.42	16,210	(1)	4,822	(1)	4,190	(1)	6,505	(1)	------	721
Washington	8.66	4,067	11,794	5,885	17,067	62	180	------	------	------	908
West Virginia	4.30	104,402	136,215	98,696	130,023	7,672	11,054	6,612	8,912	------	2,219
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	7.86	201,503	618,696	123,947	339,968	23,098	115,490	49,400	150,397		2,977
Undistributed	------	------	483,119	------	439,125	------	36,671	------	97,156	------	------
Total byproduct, 1936	5.66	3,577,222	7,265,615	2,581,230	5,111,445	369,410	857,732	697,918	1,477,045	9,006	285,775
At merchant plants	6.42	1,115,972	2,760,246	727,941	1,826,518	70,651	239,240	357,691	809,489	2,769	122,359
At furnace plants	5.37	2,461,250	4,505,369	1,853,289	3,284,927	298,759	618,492	340,227	667,556	6,237	163,416
Total byproduct, 1935	5.84	2,863,077	5,806,163	2,137,310	4,260,692	278,286	677,195	693,349	1,453,852	4,438	265,904
Change in 1936 ... percent	−3.1	+24.9	+25.1	+20.8	+20.0	+32.7	+26.7	+0.7	+1.6	+102.9	+7.5

Beehive ovens:											
Colorado	[2] 0.14	1,357	(1)					1,357	(1)		
Pennsylvania	[2] 4.65	52,887	22,096					32,362	6,030	28,784	3,615
Utah	[2] 9.02	880	(1)					6,590	(1)		88
Virginia	[2] 2.16	5,025	14,519	133	561	24	101	4,868	13,857		20
West Virginia	[2] 2.07	1,200	216					1,200	216		220
Undistributed			1,911						9,899		
Total beehive, 1936	[2] 4.01	61,349	38,742	133	561	24	101	46,377	30,002	[3] 28,784	3,943

[1] Included under "Undistributed."
[2] Yield computed by dividing the production of breeze at the few plants reporting by the quantity of coal charged at these plants.
[3] As reported; quantity produced but not used was undoubtedly greater. *See* Mineral Resources, 1922, pt. II, pp. 726–727.

CONSUMPTION OF COKE

TABLE 25.—*Quantity of coke consumed in manufacture of pig iron and for other purposes, 1913, 1918, and 1934–36, in net tons*

Year	Total production of coke	Imports	Exports	Net changes in stocks	Indicated United States consumption [1]	Consumed by iron furnaces [2]		Remainder consumed in other ways	
						Quantity	Percent	Quantity	Percent
1913	46,299,530	101,212	987,395	(3)	45,413,347	37,192,287	81.9	8,221,060	18.1
1918	56,478,372	30,168	1,687,824	(3)	54,820,716	45,703,594	83.4	9,117,122	16.6
1934	31,821,576	160,934	942,785	+733,343	30,306,382	16,183,070	53.4	14,123,312	46.6
1935	35,141,261	317,379	613,975	−769,159	35,613,824	20,821,286	58.5	14,792,538	41.5
1936	46,275,184	329,957	670,312	−1,097,318	47,032,147	31,255,648	66.5	15,776,499	33.5

[1] Production plus imports minus exports, plus or minus the decrease or increase, respectively, of the net changes in stocks.
[2] From Annual Report of American Iron and Steel Institute. Figures include coke consumed in the manufacture of ferro-alloys.
[3] Data not available.

TABLE 26.—*Pounds of coke and coking coal consumed per gross ton of pig iron made in the United States, 1913, 1918, and 1934–36*

Year	Pounds of coke per gross ton of pig iron and ferro-alloys [1]	Percent yield of coke from coal	Calculated pounds coking coal per gross ton of pig iron and ferro-alloys	Year	Pounds of coke per gross ton of pig iron and ferro-alloys [1]	Percent yield of coke from coal	Calculated pounds coking coal per gross ton of pig iron and ferro-alloys
1913	2,433.3	66.9	3,637.2	1935	1,975.1	69.6	2,837.8
1918	2,375.2	66.4	3,577.1	1936	2,036.2	70.2	2,900.6
1934	2,025.3	69.2	2,926.7				

[1] From Report of American Iron and Steel Institute; the consumption per ton of pig iron only, excluding the furnaces making ferro-alloys, was 1,989.3 in 1934, 1,950.6 in 1935, and 2,006.2 in 1936.

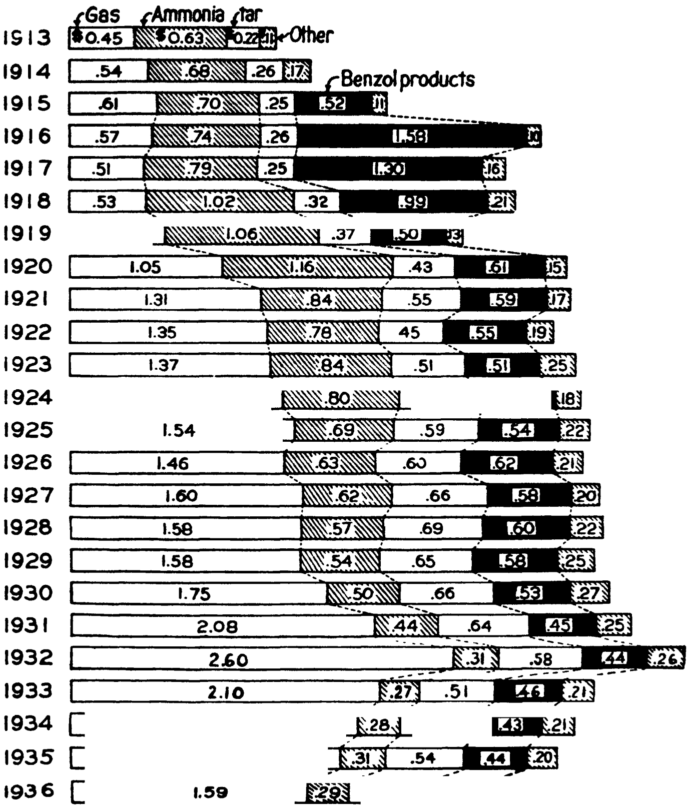


FIGURE 60.—Declining consumption of blast-furnace coke per gross ton of pig iron, 1913–36. The quantity of coke consumed per ton of pig iron has been declining. At the same time, the yield of coke per ton of coal carbonized has increased slightly, so that the consumption of coking coal per ton of pig iron produced has declined from 3,637 pounds in 1913 to 2,901 pounds in 1936.

FURNACE, FOUNDRY, AND OTHER COKE

TABLE 27.—*Byproduct coke produced and sold or used by producer in 1936, by States*

[Exclusive of screenings or breeze]

State	Produced		Used by producer in blast furnace etc.[1]		Sold									
					Furnace[2]		Foundry		Domestic use		Industrial and other use (including water gas)[3]		Total	
	Net tons	*Value*	*Net tons*	*Value*	*Net tons*	*Value*	*Net tons*	*Value*	*Net tons*	*Value*	*Net tons*	*Value*	*Net tons*	*Value*
Alabama	3,089,622	$8,774,694	2,494,780	$6,084,200	50,075	$163,704	319,083	$1,718,282	286,171	$973,038	108,462	$330,090	763,791	$3,185,114
Colorado	337,341	(4)	310,812	(4)	-----	-----	7,114	(4)	1,7992	(4)	17,99	(4)	26,898	(4)
Illinois	2,082,516	13,098,787	846,925	4,996,558	56,938	296,511	238,090	2,026,154	999,890	6,152,053	63,451	379,793	1,358,369	8,854,511
Indiana	5,449,755	40,627,036	4,841,370	36,975,035	(4)	(4)	165,312	1,370,458	403,402	2,033,416	(4)	(4)	630,214	3,796,712
Maryland	1,217,039	(4)	1,149,099	(4)	-----	-----	-----	-----	101	(4)	66,289	(4)	66,390	(4)
Massachusetts	1,108,219	6,766,722	148,352	917,250	15,917	89,004	35,579	255,950	901,522	5,463,489	13,322	84,768	966,340	5,893,211
Michigan	2,293,653	13,738,700	577,971	3,588,789	(4)	(4)	(4)	(4)	1,230,643	7,421,187	100,448	591,999	1,736,192	10,271,670
Minnesota	521,518	4,120,984	106,363	526,599	-----	-----	273	2,454	450,995	3,922,368	23,125	165,984	474,393	4,090,806
New Jersey	1,007,500	(4)	162,968	(4)	25,012	(4)	35,190	(4)	574,909	(4)	226,731	(4)	861,842	(4)
New York	4,835,921	28,566,271	789,566	4,795,443	1,152,132	5,744,919	(4)	(4)	1,785,523	12,001,451	(4)	(4)	3,189,689	19,609,101
Ohio	6,242,300	26,938,007	4,763,254	20,217,505	317,490	1,314,825	191,885	1,122,683	830,873	3,718,433	148,390	667,123	1,488,638	6,823,064
Pennsylvania	12,570,816	49,644,435	10,305,678	38,134,055	1,346,969	5,524,137	183,908	1,479,650	762,971	4,314,988	187,893	1,013,071	2,481,741	12,331,846
Tennessee	83,305	376,539	21,198	64,315	-----	-----	32,417	245,360	41,691	105,477	42,000	205,059	116,108	555,896
Utah	124,346	(4)	78,614	(4)	-----	-----	-----	-----	4,656	(4)	41,085	(4)	45,741	(4)
Washington	28,368	170,208	23,942	143,655	-----	-----	666	4,635	4,689	27,546	588	3,475	5,943	35,656
West Virginia	1,702,792	5,097,703	1,310,428	3,632,581	92,481	347,812	44,244	293,143	246,140	813,165	31,401	96,365	414,266	1,550,485
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,874,110	12,598,234	114,482	744,728	249,712	1,223,403	299,063	2,526,005	1,117,539	7,650,571	253,798	1,528,765	1,920,112	12,928,744
Undistributed	-----	15,177,399	-----	8,761,175	411,208	2,466,741	119,714	1,394,374	-----	3,897,611	187,713	3,266,561	-----	6,511,234
Grand total, 1936	44,569,121	225,695,719	28,045,802	129,581,888	3,717,934	17,171,056	1,672,538	12,439,148	9,643,507	58,494,793	1,512,688	8,333,053	16,546,667	96,438,050
At merchant plants	12,493,032	77,883,017	1,784,841	9,898,069	1,359,527	7,071,908	1,344,514	10,338,527	7,646,714	48,747,349	984,088	5,808,860	11,334,843	71,966,644
At furnace plants	32,076,089	147,812,702	26,260,961	119,683,819	2,358,407	10,099,148	328,024	2,100,621	1,996,793	9,747,444	528,600	2,524,193	5,211,824	24,471,406
Grand total, 1935	34,224,053	173,271,325	20,112,999	91,376,733	2,354,070	11,231,062	1,299,836	9,050,794	9,161,980	53,550,983	1,913,607	10,356,099	14,729,493	84,188,938
Change in 1936 ... percent	+30.2	+30.3	+39.4	+41.8	+57.9	+52.9	+28.7	+37.4	+5.3	+9.2	−21.0	−19.5	+12.3	+14.5

[1] 1936 totals include 1,459,233 tons, valued at $8,159,808 used to make producer or water gas, and 571,868 tons, valued at $3,057,077 used for other purposes than in blast furnaces.
[2] 1936 totals include 2,045,510 tons, valued at $8,621,454 sold to financially affiliated corporations for blast furnace use, and 439,978 tons, valued at $2,280,530 sold for other purposes; and 1,232,446 tons, valued at $6,269,072 reported as merchant sales.
[3] 1936 totals include 360,646 tons, valued at $2,348,700 sold for manufacture of water gas.
[4] Included under "Undistributed."

TABLE 28. B :e produced and sold used odu 936 Stat

[Exclusive of screening

State	Produced		Used by producer		Sold									
					Furnace [1]		Foundry		Domestic use		Industrial and other use (including water gas) [2]		Total	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Colorado and Utah	66,910	$378,367			60,422	$339,994	891	$5,014			4,925	$29,358	66,238	$374,366
Pennsylvania	1,213,294	4,565,024			401,297	1,445,889	173,146	809,316	356,630	$1,231,692	281,998	1,082,598	1,213,071	4,569,495
Tennessee	3,567	20,831					3,567	20,831					3,567	20,831
Virginia	191,331	811,894			94,468	382,171	26,044	125,121	231	948	68,352	294,067	189,095	802,307
Washington	312	2,160							312	2,160			312	2,160
West Virginia	230,649	899,996					45,631	235,437	20,663	78,198	164,811	588,460	231,105	902,095
Total, 1936	1,706,063	6,678,272			556,187	2,168,054	249,279	1,195,719	377,836	1,312,998	520,086	1,994,483	1,703,388	6,671,254
Total, 1935	917,208	3,581,810	108	397	119,436	518,599	184,617	883,326	264,406	893,203	322,505	1,155,837	890,964	3,450,965
Change in 1936 ... percent	+86.0	+86.4			+365.7	+318.1	+35.0	+35.4	+42.9	+47.0	+61.3	+72.5	+91.2	+93.3

[1] Totals include 158,476 tons, valued at $700,439, sold to financially affiliated corporations for blast furnace use, 12,345 tons, valued at $58,234, sold for other purposes, and 385,366 tons, valued at $1,409,381, reported as merchant sales.

[2] Totals include 24,352 tons, valued at $97,487, sold for manufacture of water gas.

DOMESTIC COKE

TABLE 29.—*Total supplies of fuels commonly used for domestic purposes in the United States, 1924 and 1933–36*

[Wherever available the figures represent the quantity actually consumed for domestic heating or for heating offices, apartments, hotels, schools, hospitals, etc. Where such figures are not available, but where the fuel is known to be used chiefly for domestic purposes, the total production (or imports) is shown to indicate the trend of growth. Data for 1936 are preliminary]

	1924	1933	1934	1935	1936
Solid fuels (net tons)					
Pennsylvania anthracite production:					
Shipments of domestic sizes	56, 576, 296	27, 755, 333	33, 269, 928	29, 653, 652	----------
Shipments of buckwheat no. 1 [1]	9, 510, 508	6, 625, 755	7, 785, 412	7, 211, 952	----------
Shipments of smaller steam sizes	11, 160, 695	8, 954, 321	9, 700, 982	9, 672, 225	----------
Local sales	3, 043, 939	3, 249, 552	3, 285, 936	2, 874, 970	----------
Total commercial production	80, 291, 438	46, 584, 961	54, 042, 258	49, 412, 799	[2] 52, 153, 000
Anthracite exported	4, 017, 785	1, 034, 562	1, 297, 610	1, 609, 000	1, 678, 000
Anthracite imported, chiefly from United Kingdom and U. S. S. R. (Russia)	117, 951	456, 252	478, 118	571, 000	615, 000
Fuel briquets produced	580, 470	530, 430	704, 856	860, 707	1, 124, 973
Fuel briquets imported	38	42, 395	----------	16, 778	20, 350
Byproduct coke sold for domestic use	2, 812, 771	10, 215, 360	10, 174, 114	9, 161, 980	9, 643, 507
Beehive coke sold for domestic use	139, 886	275, 677	346, 181	264, 406	377, 836
Coke imported	82, 833	160, 873	160, 934	317, 379	329, 957
Gas-house coke sold	[2] 1, 400, 000	[3] 498, 000	[2] 513, 200	[3] 466, 000	[2] 403, 600
Petroleum coke produced	761, 100	1, 580, 000	1, 300, 000	1, 458, 000	1, 378, 200
Anthracite and semianthracite produced outside of Pennsylvania	704, 513	350, 068	380, 055	423, 090	450, 000
Bituminous coal for domestic use	(4)	(4)	(4)	(4)	(4)
Oil (barrels of 42 gallons)					
Oil for heating buildings:					
Range oil [5]	(6)	10, 269, 000	15, 756, 000	21, 526, 000	26, 000, 000
Heating oils: [7]					
Domestic heating	5, 021, 000	----------	----------	----------	----------
Commercial heating	(6)	50, 140, 000	60, 822, 000	76, 853, 000	93, 000, 000
Liquefied petroleum gases, domestic	(6)	395, 900	421, 000	509, 000	714, 600
Gas (million cubic feet)					
Natural gas consumed for domestic and commercial use [8]	285, 152	368, 774	379, 497	413, 685	458, 000
Manufactured gas sold: [9]					
For domestic use	(6)	223, 110	216, 507	207, 451	204, 007
For house heating	(6)	20, 037	28, 181	35, 040	42, 430

[1] A considerable part of the Buckwheat No. 1 is used for domestic purposes.
[2] Partly estimated.
[3] Based on figures from Census of Manufactures.
[4] Between 56,000,000 and 77,000,000 tons a year.
[5] Range oil is a light distillate used for house heating, hot-water heating, and cooking.
[6] Data not available.
[7] Includes all grades of fuel oil used for heating buildings, both houses and offices, hotels, apartments, schools, hospitals, and other large buildings. Includes classifications formerly reported by the Bureau of Mines as "furnace oil", "domestic-heating oil", and "commercial-heating oil." Separation between domestic and commercial heating not available after 1931. (See U. S. Bureau of Mines Mineral Market Report M. M. S. 415, Nov. 19, 1935.)
[8] Includes gas used for heating offices, hotels, apartments, schools, hospitals, and stores and other large buildings, as well as houses.
[9] American Gas Association.

STOCKS OF COKE

TABLE 30.—*Stocks of furnace, foundry, and domestic coke and of breeze on Jan. 1, 1937, by States, in net tons*

[Based on complete reports from all producers]

State	Furnace	Foundry	Domestic and other	Total coke	Breeze
Byproduct plants:					
Alabama	71,732	2,229	34,868	108,829	47,098
Colorado	1,938	66	1,745	3,749	------
Illinois	3,025	691	104,669	108,385	58,055
Indiana	19,677	919	41,419	62,015	22,020
Maryland	12,099	------	------	12,099	6,335
Massachusetts	------	------	263,460	263,460	512
Michigan	4,213	930	68,823	73,966	2,173
Minnesota	7,322	------	43,568	50,890	13,445
New Jersey	------	------	150,311	150,311	5,879
New York	[1] 6,434	(1)	227,953	234,387	57,394
Ohio	68,275	711	65,964	134,950	23,591
Pennsylvania	65,223	2,483	205,291	272,997	40,160
Tennessee	3,161	110	2,279	5,550	2,288
Utah	301	------	368	669	721
Washington	------	------	1,023	1,023	908
West Virginia	18,536	315	12,105	30,956	2,219
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	223	512	184,504	185,239	2,977
Total byproduct	[1] 282,159	[1] 8,966	1,408,350	1,699,475	285,775
At merchant plants	13,387	5,183	1,185,173	1,203,743	122,359
At furnace plants	268,757	3,798	223,177	495,732	163,416
Beehive plants:					
Pennsylvania	3,336	7,326	14,454	25,116	3,615
Tennessee	20	------	------	20	------
Utah	------	------	582	582	88
Virginia	2,241	483	------	2,724	20
Washington	------	------	25	25	------
West Virginia	25	699	3,400	4,124	220
Total beehive	5,622	8,508	18,461	32,591	3,943

[1] A small amount of foundry coke is included with furnace.

TABLE 31.—*Summary of total stocks of coke on hand at all byproduct and beehive plants at first of year, 1929 and 1933–37*

	Jan. 1, 1929	Jan. 1, 1933	Jan. 1, 1934	Jan. 1, 1935	Jan. 1, 1936	Jan. 1, 1937
Byproduct plants:						
Furnace	750,318	1,360,660	919,583	922,108	697,699	282,144
Foundry	24,426	152,222	64,552	51,069	15,504	8,981
Domestic and other	1,018,205	1,985,380	1,835,743	2,584,481	2,070,544	1,408,350
	1,792,949	3,498,262	2,819,878	3,557,658	2,783,747	1,699,475
Beehive plants:						
Furnace	38,446	12,067	5,156	3,133	2,211	5,622
Foundry	8,020	7,138	10,979	8,373	11,146	8,508
Domestic and other	8,511	7,388	29,187	29,379	32,280	18,461
	54,977	26,593	45,322	40,885	45,637	32,591
Total:						
Furnace	788,764	1,372,727	924,739	925,241	699,910	287,766
Foundry	32,446	159,360	75,531	59,442	26,650	17,489
Domestic and other	1,026,716	1,992,768	1,864,930	2,613,860	2,102,824	1,426,811
	1,847,926	3,524,855	2,865,200	3,598,543	2,829,384	1,732,066

TABLE 32.—*Total stocks of coke on hand at all furnace and nonfurnace byproduct plants on first of each month, 1935 and 1936*

[Includes furnace, foundry, and domestic, but not breeze]

Date	Furnace plants		Other plants		Total	
	1935	1936	1935	1936	1935	1936
Jan. 1	1,553,300	899,628	2,004,358	1,884,119	3,557,658	2,783,747
Feb. 1	1,437,765	758,977	1,691,513	1,351,239	3,129,278	2,110,216
Mar. 1	1,362,075	614,074	1,498,111	659,740	2,860,186	1,273,814
Apr. 1	1,292,238	631,983	1,668,585	811,689	2,960,823	1,443,672
May 1	1,329,186	566,522	1,689,830	1,019,876	3,019,016	1,586,398
June 1	1,187,675	581,443	1,603,031	1,113,975	2,790,706	1,695,418
July 1	1,175,600	597,385	1,610,978	1,104,405	2,786,578	1,701,790
Aug. 1	1,199,919	650,697	1,795,310	1,165,334	2,995,229	1,816,031
Sept. 1	1,198,931	670,086	1,992,957	1,315,871	3,191,888	1,985,957
Oct. 1	1,154,927	650,456	1,974,992	1,383,155	3,129,919	2,033,611
Nov. 1	1,030,804	578,448	1,944,522	1,307,609	2,975,326	1,886,057
Dec. 1	952,549	518,651	2,073,643	1,287,123	3,026,192	1,805,774

VALUE AND PRICE

TABLE 33.—*Average receipts per net ton for coke sold in 1936, by States*

State	Byproduct				Beehive			
	Furnace [1]	Foundry	Domestic	Other industrial, including water gas	Furnace [1]	Foundry	Domestic	Other industrial, including water gas
Alabama	$3.28	$5.39	$3.40	$3.04				
Colorado and Utah		8.00	7.86	7.64	$5.63	$5.63		$5.96
Illinois	5.25	8.51	6.15	5.99				
Indiana	([2])	8.29	5.04	6.16				
Maryland and New Jersey		8.38	6.73	5.77				
Massachusetts		7.19	6.06	6.36				
Michigan and Minnesota	([2])	8.26	6.75	6.13				
New York	4.96	([2])	6.72	6.14				
Ohio	3.90	5.85	4.48	4.50				
Pennsylvania	4.10	8.05	5.66	5.39	3.57	4.67	$3.45	3.84
Tennessee		7.57	2.53	4.88		5.84		
Virginia					4.05	4.80	4.10	4.30
Washington		6.96	5.87	5.91			6.92	
West Virginia	3.76	([2])	3.30	3.07		5.16	3.78	3.57
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	4.39	8.45	6.85	6.02				
Undistributed	5.49	8.20						
Average	5.45	7.44	6.07	5.51	3.88	4.80	3.48	3.83
At merchant plants	5.18	7.69	6.37	5.90	([3])	([3])	([3])	([3])
At furnace plants	4.29	6.40	4.88	4.78	([3])	([3])	([3])	([3])

[1] Includes coke sold to affiliated corporations and merchant sales.
[2] Included under "Undistributed."
[3] Not available.

TABLE 34.—*Average monthly prices per net ton at ovens of spot or prompt Connellsville furnace and foundry coke, 1929 and 1933–36* [1]

Month	Furnace coke					Foundry coke				
	1929	1933	1934	1935	1936	1929	1933	1934	1935	1936
January	$2.75	$1.75	$3.60	$3.85	$3.65	$3.75	$2.50	$4.25	$4.60	$4.25
February	2.90	1.75	3.50	3.85	3.65	3.75	2.50	4.25	4.60	4.25
March	2.98	1.75	3.50	3.85	3.65	3.75	2.50	4.25	4.60	4.25
April	2.78	1.75	3.85	3.85	3.65	3.75	2.50	4.60	4.60	4.25
May	2.75	1.75	3.85	3.85	3.65	3.75	2.50	4.60	4.60	4.25
June	2.75	1.81	3.85	3.59	3.65	3.75	2.56	4.60	4.15	4.25
July	2.75	2.31	3.85	3.27	3.50	3.75	2.94	4.60	3.88	4.00
August	2.73	2.55	3.85	3.29	3.61	3.75	3.15	4.60	4.00	4.00
September	2.65	2.50	3.85	3.25	3.69	3.75	3.25	4.60	4.00	4.05
October	2.65	3.50	3.85	3.53	3.75	3.75	4.05	4.60	4.20	4.25
November	2.65	3.75	3.85	3.60	3.75	3.75	4.25	4.60	4.25	4.25
December	2.64	3.75	3.85	3.57	3.92	3.75	4.25	4.60	4.15	4.40
Average	2.75	2.41	3.77	3.61	3.68	3.75	3.08	4.51	4.30	4.20

[1] Iron Age, Jan. 7, 1937.

TABLE 35.—*Average monthly prices per net ton of byproduct foundry coke, in 11 markets, 1932–36, as quoted by Steel*

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
Birmingham, Ala. (at ovens):													
1932	$4.50	$4.50	$4.50	$4.50	$4.50	$4.50	$4.25	$4.50	$4.50	$4.50	$4.15	$4.00	$4.41
1933	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.40	4.50	4.75	4.85	4.85	4.28
1934	5.00	5.00	5.00	5.40	5.50	5.70	6.00	6.00	6.00	6.00	6.00	6.00	5.63
1935	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
1936	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50
Buffalo, N. Y. (at ovens):													
1932	8.00	8.00	7.60	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.59
1933	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
1934	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
1935	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
1936	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	9.15	10.50	10.50	8.14
Chicago, Ill. (at ovens):													
1932	7.50	7.50	7.50	7.50	7.30	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.19
1933	7.00	7.00	7.00	7.00	7.00	7.15	7.50	7.50	8.00	8.00	8.00	8.00	7.43
1934	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50
1935	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	9.00	9.00	9.00	8.63
1936	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
Cincinnati, Ohio (delivered at consumers' works):													
1934	(1)	(1)	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30
1935	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.15	9.00	9.50	9.50	9.50	9.31
1936	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50
Cleveland, Ohio (delivered at consumers' works):													
1934	(1)	(1)	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25
1935	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.75	9.75	9.75	9.38
1936	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.90	10.30	10.30	9.85
Detroit, Mich. (at ovens):													
1932	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
1933	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
1934	8.00	8.00	8.15	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.39
1935	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.90	9.00	9.00	8.62
1936	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.64	10.70	10.70	9.34
Indianapolis, Ind. (delivered at consumers' works):													
1932	8.30	8.30	8.25	8.25	8.25	8.25	8.25	8.25	8.25	8.15	7.75	7.75	8.17
1933	7.75	7.75	7.75	7.75	7.75	7.75	8.05	8.25	8.75	8.75	8.75	8.75	8.15
1934	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75
1935	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	9.15	9.40	9.40	8.89
1936	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40	9.40
Newark, N. J. (delivered at consumers' works):													
1932	8.76	8.76	8.76	8.76	8.23	8.21	8.21	8.21	8.21	8.21	8.21	8.21	8.40
1933	8.21	8.21	8.21	8.21	8.21	8.21	8.21	8.21	8.51	8.71	8.71	8.71	8.36
1934	8.71	8.71	8.71	8.71	8.71	8.71	8.71	8.71	8.71	8.71	8.71	8.71	8.71
1935	8.83	9.20	9.20	9.20	9.20	9.20	9.20	9.20	9.20	9.20	9.20	9.20	9.17
1936	9.60	9.70	9.70	9.70	9.70	9.70	9.70	9.70	9.70	10.20	10.20	10.20	9.82
New England (delivered at consumers' works):													
1932	10.50	10.50	10.50	10.50	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.17
1933	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.30	10.50	10.50	10.50	10.15
1934	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.87	11.00	10.57
1935	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.40	11.50	11.50	11.12
1936	11.50	11.50	11.50	11.50	11.50	11.50	11.50	11.50	11.50	11.70	12.00	12.00	11.60
Philadelphia, Pa. (delivered at consumers' works):													
1932	8.75	8.75	8.75	8.75	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.58
1933	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.63	9.00	9.00	9.00	8.64
1934	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
1935	9.00	9.00	9.00	9.00	9.00	9.03	9.03	9.03	9.03	9.03	9.03	9.03	9.02
1936	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.88	9.88	9.88	9.50
St. Louis, Mo. (at ovens):													
1932	8.50	8.50	8.50	8.50	8.50	7.95	7.75	7.75	7.75	7.75	7.75	7.75	8.08
1933	7.75	7.75	7.75	7.75	7.75	7.75	7.75	7.75	8.15	8.50	8.75	9.00	8.03
1934	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25
1935	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.80	10.00	10.00	9.42
1936	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

1 Not quoted until March.

SHIPMENTS BY RAIL AND WATER

TABLE 36.—*Beehive coke loaded for shipment on originating railroads in the United States in 1936, by routes, as reported by coke producers* [1]

Route	State	Quantity (net tons)		Percent of total
		By States	Total	
Railroads:				
Baltimore & Ohio	Pennsylvania	191, 218	223, 216	13. 0
	West Virginia	31, 998		
Chesapeake & Ohio	do	48, 412	48, 412	2. 8
Denver & Rio Grande Western	Colorado	62, 650	74, 165	4. 3
	Utah	11, 515		
Interstate	Virginia	157, 091	157, 091	9. 1
Ligonier Valley	Pennsylvania	48, 656	48, 656	2. 8
Louisville & Nashville	Virginia	520	520	(2)
Monongahela	Pennsylvania	538, 910	538, 910	31. 3
Nashville, Chattanooga & St. Louis	Tennessee	2, 494	2, 494	. 2
New York Central	West Virginia	150, 655	150, 655	8. 7
Norfolk & Western	Virginia	36, 276	36, 276	2. 1
Northern Pacific	Washington	312	312	(2)
Pennsylvania	Pennsylvania	441, 233	441, 233	25. 6
Pittsburgh & Lake Erie	do	2, 252	2, 252	. 1
Total railroad shipments		1, 724, 192	1, 724, 192	100. 0

[1] There were no shipments of beehive coke over waterways during 1936.
[2] Less than 1/10 of 1 percent.

EXPORTS AND IMPORTS

TABLE 37.—*Coke exported from the United States, 1934–36, by customs districts*

District	1934		1935		1936	
	Net tons	Value	Net tons	Value	Net tons	Value
Alaska			1	$32		
Arizona	102	$897	28	221	274	$1, 297
Buffalo	313, 425	1, 792, 771	222, 953	1, 333, 256	302, 006	1, 906, 366
Chicago	58, 148	270, 709	65, 406	353, 516	33, 463	171, 006
Dakota			9, 984	71, 008	11, 794	86, 297
Duluth-Superior	1, 845	12, 879	2, 449	16, 886	3, 711	27, 879
El Paso	4	65	2	45	1	13
Florida	7, 247	73, 261	3, 659	31, 023	3, 472	21, 058
Galveston					31	341
Los Angeles	1	10			17	300
Maine and New Hampshire			424	3, 382	436	3, 432
Maryland	2, 355	9, 510	117	501	968	5, 481
Massachusetts					1	46
Michigan	492, 549	2, 853, 333	285, 201	1, 610, 521	246, 103	1, 508, 978
Mobile	5, 002	15, 580	1, 516	22, 801	1, 716	7, 721
Montana and Idaho	8, 623	54, 883				
New Orleans	7, 622	53, 888	4, 572	33, 533	4, 257	49, 773
New York	403	6, 831	179	3, 076	1, 030	11, 756
Ohio	41, 697	223, 036	12, 551	63, 047	31, 787	185, 176
Oregon	30	180				
Philadelphia	2, 483	39, 398	3, 855	37, 641	7, 251	68, 517
Puerto Rico	40	467	19	219	28	320
Sabine					2	43
St. Lawrence	723	7, 523	214	1, 680	5, 516	41, 601
San Antonio	4	74	284	1, 983	328	2, 460
San Diego	145	1, 722	337	3, 686	540	6, 067
San Francisco	9	130	13	232	6	47
Vermont			63	480		
Virginia	320	2, 482	147	1, 359	237	1, 849
Washington	8	109	1	15	310	3, 040
Wisconsin					15, 027	80, 271
	942, 785	5, 419, 738	613, 975	3, 590, 143	670, 312	4, 191, 135

Table 38.—*Coke exported from the United States, 1934–36, by countries of destination*

Destination	1934		1935		1936	
	Net tons	Value	Net tons	Value	Net tons	Value
North America:						
Bermuda	11	$170	21	$344	16	$210
Canada	917,018	5,215,243	599,202	3,453,607	650,036	4,013,243
Central America:						
British Honduras			34	570		
Costa Rica	40	617	11	190	6	93
Guatemala	80	1,152	62	825	25	390
Honduras	54	744	43	598	47	625
Nicaragua	40	770	43	834	64	1,210
Panama	115	1,869	293	4,161	519	7,069
Salvador	38	587	50	1,019	71	1,864
Mexico	316	3,589	738	6,950	1,365	12,555
West Indies:						
Cuba	14,034	66,053	6,700	44,219	2,257	10,597
Dominican Republic	57	794	27	326	71	933
French	20	93	63	564	114	832
Haiti	3	67			4	89
Jamaica			28	530		
Netherland	18	152				
Trinidad and Tobago			120	1,219	2	23
South America:						
Bolivia	88	1,446			802	5,966
Brazil			1	15		
Chile	2,346	9,559	109	411	918	5,896
Colombia	120	1,857	47	654	7	86
Ecuador	29	458	30	476	28	506
Peru	123	1,680	125	935		
Venezuela	44	733	13	267	11	107
Europe:						
Belgium	213	3,000				
France	601	9,197	454	6,912	4,359	36,546
Germany			437	5,216		
Hungary			6	111		
Italy	6,543	88,362	1,684	25,250	3,125	42,933
Netherlands			1,226	10,944	487	4,282
Norway	568	9,139	1,252	14,915	2,253	20,745
Sweden	30	180	1,108	7,753		
United Kingdom	6	78	44	216	3,639	23,402
Asia:						
China	31	556				
Japan					17	300
Philippine Islands	199	1,593	4	112		
Oceania:						
Australia					27	193
French					41	415
Africa: Liberia					1	25
	942,785	5,419,738	613,975	3,590,143	670,312	4,191,135

Table 39.—*Coke imported for consumption in the United States, 1934–36, by customs districts*

District	1934		1935		1936	
	Net tons	Value	Net tons	Value	Net tons	Value
Buffalo	13,027	$229,631	22,439	$390,068	30,523	$463,694
Connecticut	3,298	15,819	116	2,317		
Dakota					2	26
Florida			6	26		
Hawaii	426	4,085	1,136	5,166	317	2,295
Los Angeles	21,759	72,712	34,210	107,033	38,100	133,945
Massachusetts	77,336	355,573	113,132	487,452	74,165	286,291
Maine and New Hampshire	197	1,470	237	1,751	233	1,654
Michigan	579	8,718	139	2,428	1,027	15,811
Montana and Idaho	7,292	39,473	20,252	103,035	18,911	97,800
New York			80,152	309,815	120,225	464,796
Oregon	2,593	9,009	2,502	10,003	2,682	10,537
Rhode Island	10,036	41,994	3,882	18,025	8,360	34,722
St. Lawrence					697	4,516
San Antonio	1,928	8,679	5,937	26,538	516	2,309
San Francisco	17,582	61,127	23,092	71,455	24,011	78,578
Vermont	35	248	76	528	143	1,018
Washington	4,846	16,313	10,071	38,938	10,045	37,509
	160,934	864,851	317,379	1,574,578	329,957	1,635,501

TABLE 40.—*Coke imported for consumption in the United States, 1934–36, by countries*

Country	1934		1935		1936	
	Net tons	Value	Net tons	Value	Net tons	Value
Belgium	1,711	$4,914	60,838	$216,887	158,920	$606,181
Canada	21,130	279,540	46,150	514,711	52,729	590,702
Germany	29,847	128,627	120,340	466,922	31,750	78,554
Mexico	1,928	8,679	5,937	26,538	516	2,309
Netherlands					27,795	115,194
Poland and Danzig					3,818	13,837
United Kingdom	106,318	443,091	84,114	349,520	54,429	228,724
	160,934	864,851	317,379	1,574,578	329,957	1,635,501

WORLD PRODUCTION

TABLE 41.—*Coke produced in principal countries, 1929 and 1933–36, in metric tons*[1]

[Compiled by M. T. Latus]

Country	1929	1933	1934	1935	1936
Australia:					
New South Wales	471,813	481,026	699,673	871,644	(2)
Queensland	4,144	15,337	26,067	25,276	(2)
Belgium	6,192,960	4,694,130	4,601,950	4,678,400	5,050,000
Bulgaria		628	935	1,705	1,683
Canada	1,986,532	1,228,246	1,658,691	1,663,515	1,809,204
China (exports)	13,467	1,709	6,531	7,246	11,422
Chosen	(3)	220,500	246,900	(3)	(2)
Czechoslovakia	3,170,629	1,259,381	1,344,786	1,553,869	1,955,000
France	9,080,127	6,787,600	7,293,110	7,078,000	7,030,000
Germany	39,421,033	21,153,744	24,484,890	29,556,269	35,861,000
Saar	2,423,000	1,880,000	2,180,000	(4)	(4)
Great Britain [5]	13,637,421	8,919,540	11,697,111	12,131,081	(2)
Hungary	2,092	9,163	19,086	22,981	30,704
India, British [6]	843,504	1,247,451	1,541,487	1,795,178	(2)
Indochina	637	360	285	260	(2)
Italy	791,607	729,966	817,243	998,382	(2)
Japan:					
Manufactured coke	(3)	(3)	(3)	(3)	(3)
Natural coke	(3)	370,785	367,236	396,214	(2)
Mexico	493,777	251,604	275,176	489,047	(2)
Netherlands	2,402,566	2,609,373	2,779,378	2,878,191	(2)
Peru	35,899	(3)	(3)	(3)	(2)
Poland	1,858,052	1,170,717	1,333,493	1,386,716	1,615,598
Rhodesia, Southern	100,001	31,798	55,979	39,239	(2)
Rumania		7,150	31,914	45,920	63,391
Spain	768,040	427,453	485,634	(3)	(2)
Straits Settlements	15,667	7,860	8,549	9,324	(2)
Sweden	103,778	103,336	107,370	114,464	115,430
Union of South Africa	99,297	75,456	72,969	64,782	75,459
U. S. S. R. (Russia)	4,700,000	10,225,000	14,221,000	16,752,000	19,883,000
United States	54,325,427	25,028,365	28,867,897	31,879,449	41,979,921
	144,481,000	90,218,000	106,505,000	115,969,000	(2)

[1] Gas-house coke is not included.
[2] Data not available.
[3] Estimate included in total.
[4] Beginning with March 1935, production of the Saar is included with that of Germany.
[5] In Great Britain the production of gas-house coke (including breeze), not included above, is especially important and was as follows: 1933, 11,657,081 tons; 1934, 12,038,825 tons; 1935, 12,181,117 tons.
[6] Figures for 1929 represent "hard" and "soft" coke made at collieries only (73,616 tons of "hard" coke and 769,888 tons of "soft" coke). Data for other years shown represent total "hard" coke manufactured. In addition, the following quantities of "soft" coke were made at collieries: 1933, 837,393 tons; 1934, 874,901 tons; 1935, 904,840 tons.

COKE-OVEN BYPRODUCTS

SUMMARY OF BYPRODUCTS IN 1936

TABLE 42.—*Byproducts obtained from coke-oven operations in the United States in 1936* [1]

[Exclusive of screenings or breeze]

Product	Production	Sales		
		Quantity	Value	
			Total	Average
Tar ..... gallons	560, 385, 578	358, 182, 759	$15, 328, 340	$0.043
Ammonia:				
Sulphate ..... pounds	1, 199, 645, 603	1, 123, 343, 067	11, 484, 191	.010
Ammonia liquor (NH_3 content) ..... do	47, 259, 245	46, 907, 237	1, 328, 788	.028
	.....	.....	12, 812, 979	.....
Sulphate equivalent of all forms ..... do	1, 388, 682, 583	1, 310, 972, 015	.....	.....
Gas:				
Used under boilers, etc. ..... M cubic feet	[2] 699,701, 415	28, 807, 618	1, 764, 469	.061
Used in steel or affiliated plants ..... do		226, 229, 045	21, 717, 052	.096
Distributed through city mains ..... do		156, 063, 794	44, 711, 670	.286
Sold for industrial use ..... do		22, 538, 584	2, 637, 779	.117
	.....	433, 639, 041	70, 830, 970	.163
Light oil and derivatives:				
Crude light oil ..... gallons	[3] 170, 234, 202	10, 363, 176	971, 764	.094
Benzol, crude and refined ..... do	19, 412, 593	19, 145, 088	2, 675, 932	.140
Motor benzol ..... do	85, 672, 953	84, 761, 655	7, 628, 935	.090
Toluol, crude and refined ..... do	19, 807, 383	19, 695, 792	5, 403, 424	.274
Solvent naphtha ..... do	5, 189, 232	4, 961, 433	916, 505	.185
Xylol ..... do	4, 216, 081	4, 206, 525	1, 121, 032	.266
Other light-oil products ..... do	6, 673, 992	3, 523, 836	221, 185	.063
	[4] 140, 972, 234	146, 657, 505	18, 938, 777	.129
Naphthalene, crude and refined ..... pounds	37, 552, 219	34, 946, 890	570, 295	.016
Tar derivatives:				
Creosote oil, distillate as such ..... gallons	16, 052, 953	10, 418, 339	939, 989	.090
Creosote oil in coal-tar solution ..... do	2, 116, 481	1, 219, 983	111, 763	.092
Pitch of tar ..... net tons	68, 339	4, 372	33, 127	7.577
Other tar derivatives	.....	.....	417, 966	.....
Phenol ..... gallons	75, 612	74, 160	27, 116	.366
Sodium phenolate ..... do	162, 334	168, 145	12, 730	.076
Other products [5]	.....	.....	181, 581	.....
Value of all byproducts sold	.....	.....	[6] 120, 205, 633	.....

[1] Includes products of tar distillation conducted by coke-oven operators under same corporate name, except, however, phenol and other tar acids produced at Clairton, Pa.
[2] Includes gas wasted and gas used for heating retorts.
[3] Refined on the premises to make the derived products shown, 163,990,960 gallons.
[4] Total gallons of derived products.
[5] Ammonia thiocyanate, asphalt paint, carbolates, cyanimid crystals, cyanogen sludge, ferrocyanide, insecticides, light carbolic oils, pyridine oil, sodium prussiate, spent soda solution, sulphur, and vented vapors.
[6] Exclusive of the value of breeze production, which in 1936 amounted to $7,265,615.

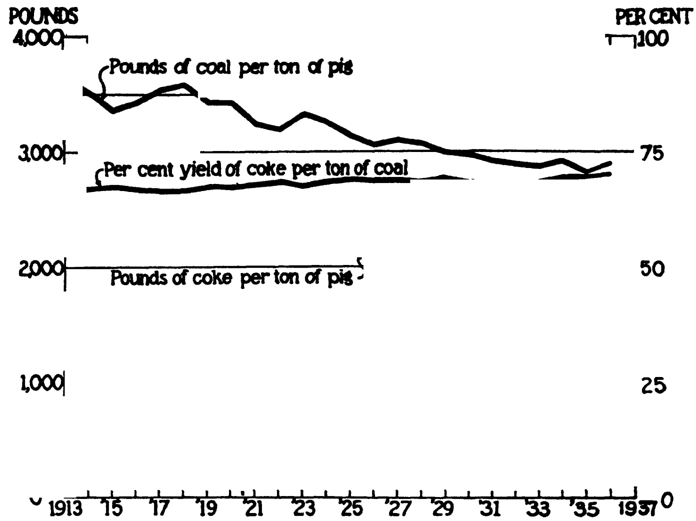


FIGURE 61.—Gross value of the several byproducts per ton of byproduct coke produced, 1913–36.

TABLE 43.—*Coal equivalent of byproducts of byproduct coking, 1913, 1914, 1918, and 1934–36*

Year	Quantity of byproducts				Rough equivalent in heating value (billion B. t. u.)					Coal equivalent	
	1	2	3	4	5	6	7	8	9	10	11
	Coke breeze (thousand net tons)	Surplus gas (billion cubic feet)	Tar produced (thousand gallons)	Light oil produced (thousand gallons)	Coke breeze (1×20)	Surplus gas (2×550)	Tar (3× 0.150)	Light oil (4× 0.130)	Total (5+6+ 7+8)	Net tons (9÷0.0262)	Percent this forms of coal made into coke
1913	735	64	115, 145	3, 000	14, 700	35, 200	17, 272	390	67, 562	2, 600, 000	3. 8
1914	667	61	109, 901	8, 464	13, 340	33, 550	16, 485	1, 100	64, 475	2, 461, 000	4. 8
1918	1, 999	158	263, 299	87, 562	39, 980	86, 900	39, 495	11, 383	177, 758	6, 785, 000	8. 0
1934	2, 731	310	408, 710	115, 695	54, 620	170, 500	61, 307	15, 040	301, 467	1, 506, 000	25. 0
1935	2, 863	346	450, 308	133, 697	57, 260	190, 300	67, 546	17, 381	332, 487	12, 690, 000	25. 1
1936	3, 577	434	560, 386	170, 234	71, 540	238, 700	84, 058	22, 130	416, 428	15, 894, 000	24. 1

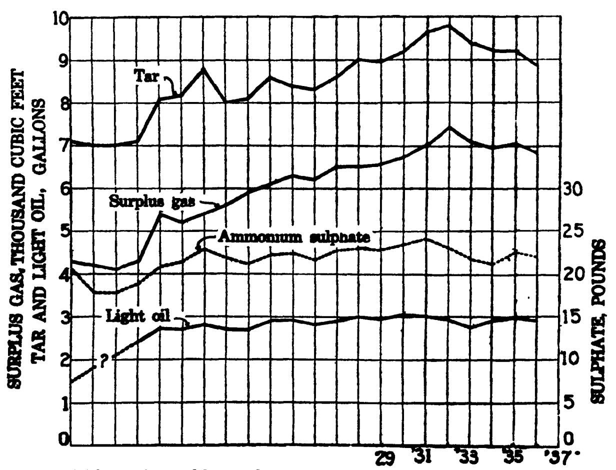


FIGURE 62.—Average yield of principal byproducts per net ton of coal carbonized in byproduct coke ovens 1915–36. Figures for light oil represent average at plants recovering light oil.

COKE-OVEN GAS

TABLE 44.—*Coke-oven gas produced and sold in the United States in 1936, by States*

State	Number of active plants	Produced (M cubic feet)	Used in heating ovens (M cubic feet)	Surplus sold or used			Wasted (M cubic feet)
				M cubic feet	Value		
					Total	Average	
Alabama	7	49, 266, 145	21, 521, 385	25, 011, 455	$1, 853, 861	$0. 074	2, 733, 305
Colorado	1	5, 913, 553	2, 815, 690	3, 070, 939	(1)	(1)	26, 924
Illinois	8	30, 680, 872	7, 434, 074	22, 556, 655	4, 569, 024	. 203	690, 143
Indiana	6	81, 458, 423	32, 398, 764	47, 687, 258	7, 014, 979	. 147	1, 372, 401
Maryland	1	17, 234, 489	7, 727, 847	9, 506, 642	(1)	(1)	----------
Massachusetts	3	18, 854, 793	5, 643, 311	13, 152, 792	3, 754, 395	. 285	58, 690
Michigan	8	38, 165, 819	14, 046, 080	24, 095, 514	4, 449, 820	. 185	24, 225
Minnesota	3	8, 581, 428	3, 646, 985	4, 862, 957	1, 559, 039	. 321	71, 486
New Jersey	2	16, 755, 327	3, 647, 819	13, 107, 508	(1)	(1)	----------
New York	8	71, 685, 700	18, 004, 034	51, 786, 400	15, 521, 420	. 300	1, 895, 266
Ohio	13	93, 032, 883	39, 169, 699	52, 918, 590	5, 656, 050	. 107	944, 594
Pennsylvania	12	208, 571, 379	82, 681, 832	122, 095, 021	13, 832, 798	. 113	3, 794, 526
Tennessee	1	1, 142, 504	514, 124	628, 380	187, 447	. 298	----------
Utah	1	2, 732, 799	1, 253, 800	1, 463, 179	(1)	(1)	15, 820
Washington	1	553, 360	------------	501, 178	132, 534	. 264	52, 182
West Virginia	4	26, 532, 416	7, 937, 647	18, 532, 614	1, 576, 793	. 085	62, 155
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	6	28, 539, 525	5, 682, 824	22, 661, 959	6, 682, 019	. 295	194, 742
Undistributed	-------	------------	------------	------------	4, 040, 791	. 149	----------
Grand total, 1936	85	699, 701, 415	254, 125, 915	433, 639, 041	70, 830, 970	. 163	11, 936, 459
At merchant plants	43	193, 160, 902	47, 698, 769	142, 305, 582	39, 225, 329	. 276	3, 156, 551
At furnace plants	42	506, 540, 513	206, 427, 146	291, 333, 459	31, 605, 641	. 108	8, 779, 908
Grand total, 1935	81	543, 396, 088	190, 942, 280	345, 516, 257	62, 715, 048	. 182	6, 937, 551
Change in 1936 percent	+4. 9	+28. 8	+33. 1	+25. 5	+12. 9	−10. 4	+72. 1

[1] Included under "Undistributed."

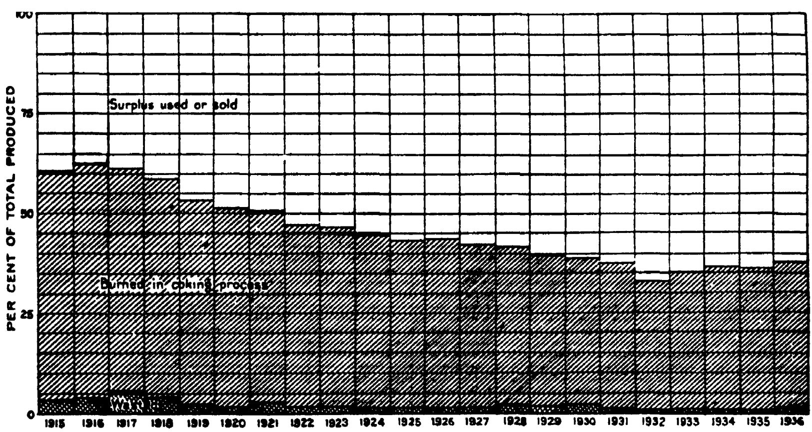


FIGURE 63.—Percent of total production of byproduct oven gas that was wasted, burned in coking processes, or sold or used, 1915–36.

TABLE 45.—*Disposition of surplus coke-oven gas in the United States in 1936, by States*

State	Used by producer					
	Under boilers			In steel or other affiliated plants		
	M cubic feet	Value		M cubic feet	Value	
		Total	Average		Total	Average
Alabama	6,524,049	$317,382	$0.049	14,002,386	$956,976	$0.068
Colorado				3,070,939	(1)	(1)
Illinois	1,219,819	82,310	.067	3,083,794	431,685	.140
Indiana	3,409,210	275,710	.081	36,750,074	4,634,222	.126
Maryland				3,963,801	(1)	(1)
Massachusetts	2,630	484	.184	1,530	459	.300
Michigan	1,724,385	86,219	.050	7,566,300	1,140,827	.151
Minnesota	701,974	39,084	.056	207,960	(1)	(1)
New Jersey	31,593	(1)	(1)			
New York	2,493,817	147,464	.059	13,356,358	1,376,888	.103
Ohio	1,161,320	128,911	.111	40,721,858	3,768,254	.093
Pennsylvania	10,158,029	584,358	.058	87,141,911	7,324,261	.084
Tennessee	116,390	22,091	.190			
Utah	832,252	(1)	(1)	27,156	(1)	(1)
Washington	3,045	152	.050			
West Virginia	265,242	15,666	.059	16,334,978	1,247,413	.076
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	163,863	(1)	(1)			
Undistributed		64,638	.063		836,067	.115
Grand total, 1936	28,807,618	1,764,469	.061	226,229,045	21,717,052	.096
At merchant plants	7,129,503	523,671	.073	3,109,258	199,507	.064
At furnace plants	21,678,115	1,240,798	.057	223,119,787	21,517,545	.096
Grand total, 1935	19,788,904	1,300,371	.066	160,811,880	15,222,869	.095
Change in 1936 ... percent	+45.6	+35.7	−7.6	+40.7	+42.7	+1.1

State	Sold					
	Distributed through city mains			Sold for industrial purposes		
	M cubic feet	Value		M cubic feet	Value	
		Total	Average		Total	Average
Alabama	3,768,797	$511,891	$0.136	716,223	$67,612	$0.094
Illinois	18,253,042	4,055,029	.222			
Indiana	6,404,692	1,886,150	.294	1,123,282	218,897	.195
Maryland	5,542,841	(1)	(1)			
Massachusetts	13,111,684	3,746,654	.286	36,948	(1)	(1)
Michigan	12,730,004	3,038,440	.239	2,074,825	184,334	.089
Minnesota	3,953,023	1,496,683	.379			
New Jersey	13,075,915	(1)	(1)			
New York	34,054,337	13,616,393	.400	1,881,888	380,675	.202
Ohio	7,325,362	1,367,674	.187	3,710,050	391,211	.105
Pennsylvania	17,281,103	5,235,890	.303	7,513,978	688,289	.092
Tennessee	511,990	165,356	.323			
Utah	455,472	(1)	(1)	148,299	(1)	(1)
Washington	498,133	132,382	.266			
West Virginia				1,932,394	313,714	.162
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	19,097,399	6,292,685	.330	3,400,697	372,292	.109
Undistributed		3,166,443	.166		20,755	.112
Grand total, 1936	156,063,794	44,711,670	.286	22,538,584	2,637,779	.117
At merchant plants	118,824,729	36,807,546	.310	13,242,092	1,694,605	.128
At furnace plants	37,239,065	7,904,124	.212	9,296,492	943,174	.101
Grand total, 1935	151,255,723	44,510,704	.294	13,659,750	1,681,104	.123
Change in 1936 ... percent	+3.2	+0.5	−2.7	+65.0	+56.9	−4.9

1 Included under "Undistributed".

TAR

TABLE 46.—*Coke-oven tar produced and sold in the United States in 1936, by States* [1]

	Total produced [1]	Yield of tar per ton of coal coked[1]	Sold [2]				
			For use as fuel [3]	For refining into tar products	Total sold	Value	
						Total	Average
	Gallons	*Gallons*	*Gallons*	*Gallons*	*Gallons*		
Alabama	39,104,325	9.47	24,025,966	4,299,122	28,325,088	$1,268,662	$0.045
Colorado	5,319,300	10.51	1,201	245,155	246,356	(4)	(4)
Illinois	25,628,667	8.45	6,340,011	19,976,398	26,316,409	1,156,289	.044
Indiana	47,479,076	6.41	4,231,694	22,845,339	27,077,033	1,232,161	.046
Maryland	12,875,952	7.65	----------	12,294,222	12,294,222	(4)	(4)
Massachusetts	13,023,900	8.31	12,277,120	648,013	12,925,133	669,917	.052
Michigan	27,115,806	8.50	1,433,551	18,745,224	20,178,775	781,817	.039
Minnesota	5,882,189	7.81	----------	5,637,821	5,637,821	258,321	.046
New Jersey	11,382,158	8.03	3,995,366	7,369,751	11,365,117	(4)	(4)
New York	61,889,829	9.20	16,671,274	41,580,007	58,251,281	2,448,776	.042
Ohio	73,499,404	8.39	16,538,112	37,218,016	53,756,128	2,518,137	.047
Pennsylvania	189,066,960	10.29	32,705,447	23,970,402	56,675,849	1,938,265	.034
Tennessee	716,943	5.93	----------	722,487	722,487	28,894	.040
Utah	2,491,337	11.40	----------	2,445,291	2,445,291	(4)	(4)
Washington	330,868	7.04	317,476	----------	317,476	7,937	.025
West Virginia	24,971,747	10.29	----------	21,879,761	21,879,761	945,241	.043
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	19,607,117	7.65	----------	19,768,532	19,768,532	851,259	.043
Undistributed	----------	----------	----------	----------	----------	1,222,664	.046
Grand total, 1936	560,385,578	8.86	118,537,218	239,645,541	358,182,759	15,328,340	.043
At merchant plants	147,559,117	8.49	27,837,452	117,628,015	145,465,467	6,139,036	.042
At furnace plants	412,826,461	9.00	90,699,766	122,017,526	212,717,292	9,189,304	.043
Grand total, 1935	450,307,827	9.18	51,261,349	257,444,570	308,705,919	12,597,705	.041
Change in 1936 percent	+24.4	−3.5	+131.2	−6.9	+16.0	+21.7	+4.9

	Used by producer [2]			On hand Dec. 31
	As fuel under boilers	In open-hearth or affiliated plants	Otherwise	
	Gallons	*Gallons*	*Gallons*	*Gallons*
Alabama	161,804	10,449,372	207,604	2,217,572
Colorado	----------	694,006	44,244	468,845
Illinois	----------	118,511	----------	1,320,821
Indiana	----------	20,450,247	13,131	2,958,059
Maryland	----------	9,259	----------	1,902,393
Massachusetts	----------	----------	30,000	25,998
Michigan	7,437	6,324,090	----------	2,150,103
Minnesota	----------	----------	----------	463,009
New Jersey	----------	----------	----------	658,490
New York	----------	107,364	9,619	3,885,257
Ohio	824,874	20,006,311	----------	1,849,034
Pennsylvania	745,211	84,459,408	168,485	10,033,463
Tennessee	----------	----------	----------	32,366
Utah	----------	1,100	1,971	147,327
Washington	----------	----------	----------	34,096
West Virginia	----------	3,004,222	----------	663,815
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin		----------	975	602,571
Undistributed	----------	----------	----------	----------
Grand total, 1936	1,739,326	145,623,890	476,029	29,413,219
At merchant plants	----------	----------	40,904	6,651,747
At furnace plants	1,739,326	145,623,890	435,125	22,761,472
Grand total, 1935	1,804,683	91,631,693	1,921,561	34,915,675
Change in 1936 percent	−3.6	+58.9	−75.2	−15.8

[1] Includes 58,011,165 gallons of tar "refined at plant".
[2] Excludes 58,011,165 gallons of tar "refined at plant" which cannot be shown by States due to disclosure of individual operations.
[3] Includes 22,685,478 gallons sold to affiliated corporations and 95,851,740 gallons sold to other purchasers.
[4] Included under "undistributed".

AMMONIA

TABLE 47.—*Ammonia produced at coke-oven plants in 1936, by States, in pounds*

State	Number of active plants	Sulphate equivalent of all forms		Produced as—	
		Total	Per ton of coal coked	Sulphate	Liquor (NH_3 content)
Alabama	7	108,700,948	24.51	105,843,312	714,409
Colorado	1	11,688,900	23.10	11,688,900	
Illinois	7	65,541,566	22.26	47,802,886	4,434,670
Indiana	6	137,351,342	18.54	126,021,978	2,832,341
Maryland	1	37,687,276	22.38	37,687,276	
Massachusetts	3	37,046,301	23.65	35,997,305	262,249
Michigan	8	67,907,292	21.29	23,233,252	11,168,510
Minnesota	3	11,160,802	14.81	11,160,802	
New Jersey	2	28,856,047	20.36	28,856,047	
New York	8	148,656,926	22.09	119,751,266	7,226,415
Ohio	13	189,299,749	21.61	152,356,949	9,235,700
Pennsylvania	12	432,614,924	23.54	422,717,036	2,474,47
Tennessee	1	2,784,543	23.05	2,784,543	
Utah	1	5,804,059	26.55	5,804,059	
West Virginia	3	49,192,333	23.58	49,192,333	
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	5	54,389,575	21.47	18,747,659	8,910,479
Grand total, 1936	81	1,388,682,583	22.14	1,199,645,603	47,259,245
At merchant plants	39	371,908,462	22.05	220,600,250	37,827,053
At furnace plants	42	1,016,774,121	22.17	979,045,353	9,432,192
Grand total, 1935	77	1,090,623,535	22.59	923,513,235	41,777,575
Change in 1936 ... percent	+5.2	+27.3	−2.0	+29.9	+13.1

LIGHT OIL AND ITS DERIVATIVES

TABLE 48.—*Crude light oil produced at coke-oven plants in the United States in 1936, by States, in gallons* [1]

State	Number of active plants	Produced		Refined on premises	Total derived products obtained from refining operations
		Total	Per ton of coal coked		
Alabama	7	13,114,911	2.96	12,991,815	11,244,143
Colorado	1	1,634,391	3.23	1,634,284	1,229,238
Illinois	4	7,087,557	2.64	2,356,179	2,147,725
Indiana	4	18,199,021	2.66	19,563,699	16,994,427
Maryland	1	5,394,477	3.20	5,412,814	4,922,178
Michigan	3	6,655,280	2.32	3,410,653	3,194,954
New York	7	14,827,393	2.49	24,507,247	20,694,943
Ohio	13	25,570,953	2.92	22,794,922	18,933,915
Pennsylvania	10	56,681,746	3.26	54,460,848	47,333,490
Tennessee	1	280,733	2.32	281,795	209,082
Utah	1	899,091	4.11	895,731	671,955
West Virginia	4	8,045,961	3.32	8,080,254	6,772,477
Kentucky, Massachusetts, Minnesota, Missouri, New Jersey, and Wisconsin	6	11,842,688	2.55	7,600,719	6,623,707
Grand total, 1936	62	170,234,202	2.91	163,990,960	140,972,234
At merchant plants	24	31,735,719	2.39	28,809,795	24,621,777
At furnace plants	38	138,498,483	3.06	135,181,165	116,350,457
Grand total, 1935	61	133,696,803	2.98	126,688,359	107,540,415
Change in 1936 ... percent	+1.6	+27.3	−2.3	+29.4	+31.1

[1] In addition to the quantity refined on the premises, a few plants reported the sale of crude light oil. The total quantity sold in 1936 was 10,363,176 gallons valued at $971,764 or 9.4 cents per gallon.

NAPHTHALENE

TABLE 49.—*Naphthalene sold by byproduct-coke operators, 1918 and 1933–36*

Year	Quantity (pounds)			Value	Average receipts per pound (cents)		Receipts per ton of coke (cents)
	Crude	Refined	Total		Crude	Refined	
1918	10,403,758	5,486,689	15,890,447	$650,229	2.8	6.6	2.5
1933	[1] 6,523,204		6,523,204	67,472	[1] 1.0		.3
1934	[1] 10,500,285		10,500,285	131,299	[1] 1.3		.4
1935	[1] 13,214,108		13,214,108	167,632	[1] 1.3		.5
1936	[1] 34,946,890		34,946,890	570,295	[1] 1.6		1.3

[1] Crude and refined not separated.

BYPRODUCT-COKE OVENS OWNED BY CITY GAS COMPANIES INCLUDED BY BUREAU OF THE CENSUS IN MANUFACTURED-GAS INDUSTRY

Reference has been made to the byproduct-coke plants installed by city gas companies, which the Bureau of the Census classifies as a part of the manufactured-gas industry and which the Bureau of Mines includes with the byproduct-coke industry. The difference in classification is maintained by the two offices advisedly in the interest of those who can use the statistics. For some purposes the Census grouping is more useful, while for others the grouping used by the Bureau of Mines is the more significant, particularly design of ovens, technique of manufacture, and supply and demand for coal and coke.

To compare or combine the two sets of figures allowance must be made for the difference in classification, which can be done by means of the data in table 50 prepared for the purpose by the Bureau of Mines. The table shows, in parallel columns, separate figures for the byproduct-coke plants operated by city gas companies (grouped by the Bureau of the Census with the manufactured-gas industry) and for all other byproduct-coke plants. Thus, in 1936 there were 21 active plants in the group owned by city gas companies; they produced 3,614,285 tons of coke, 59,153,561 M cubic feet of gas, 49,619,962 gallons of tar, and 3,958,497 gallons of crude light oil. By subtracting their production from the Census figures for the manufactured-gas industry, anyone interested may arrive at the quantities of the several products produced by gas works proper—that is, coal, oil, and water-gas plants.

The table also shows the operations of the 64 plants not owned by city gas companies which were active in 1936. These plants are covered by the Census classification of "Coke, not including gas-house coke, made in byproduct ovens." The figures are compiled by the Bureau of Mines from the reports of the coke producers and are accepted by the Bureau of the Census as an official record of production in the years covered by the Census of Manufactures.

The totals for both groups of plants given in the last column of the table are for the byproduct-coke industry as defined by the Bureau of Mines and given in the other tables of this report.

153336—37——60

TABLE 50.—*Production of coke, breeze, gas, and byproducts at byproduct coke plants owned by city gas companies (public utilities) and included by Bureau of the Census in manufactured-gas industry, and at all other byproduct coke plants, 1935 and 1936*

Product	1935			1936		
	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities) [1]	Total	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities) [1]	Tota
Number of active plants	60	21	81	64	21	85
Coke:						
Production.....net tons	30, 963, 117	3, 260, 936	34, 224, 053	40, 954, 836	3, 614, 285	44, 569, 121
Value	$152, 741, 222	$20, 530, 103	$173,271,325	$202, 419, 225	$23, 276, 494	$225, 695, 719
Average value	$4. 93	$6. 30	$5. 06	$4. 94	$6. 44	$5. 06
Screenings or breeze:						
Production.....net tons	2, 523, 642	339, 435	2, 863, 077	3, 232, 638	344, 584	3, 577, 222
Sales.....do	660, 593	32, 756	693, 349	670, 835	27, 083	697, 918
Value	$1, 372, 941	$80, 911	$1, 453, 852	$1, 406, 193	$70, 852	$1, 477, 045
Average value	$2. 08	$2. 47	$2. 10	$2. 10	$2. 62	$2. 12
Coal charged into ovens:						
Quantity.....net tons	44, 242, 998	4, 802, 621	49, 045, 619	58, 110, 600	5, 132, 917	63, 243, 517
Coke:						
Used by producer:						
Quantity.....net tons	19, 464, 976	648, 023	20, 112, 999	27, 051, 802	994, 000	28, 045, 802
Value	$87, 373, 745	$4, 002, 988	$91, 376, 733	$123, 442, 937	$6, 138, 951	$129, 581, 888
Sales:						
Quantity.....net tons	12, 029, 368	2, 700, 125	14, 729, 493	13, 762, 584	2, 784, 083	16, 546, 667
Value	$67, 073, 154	$17, 115, 784	$84, 188, 938	$78, 348, 913	$18, 089, 137	$96, 438, 050
Byproducts:						
Gas:						
Production..M cubic feet	488, 248, 594	55, 147, 494	543, 396, 088	640, 547, 854	59, 153, 561	699, 701, 415
Sales of surplus:						
Used under boilers:						
Quantity.M cubic feet	19, 669, 508	119, 396	19, 788, 904	28, 705, 273	102, 345	28, 807, 618
Value	$1, 263, 963	$36, 408	$1, 300, 371	$1, 754, 280	$10, 189	$1, 764, 469
Used in steel or affiliated plants:						
Quantity.M cubic feet	160, 794, 550	17, 330	160, 811, 880	226, 211, 134	17, 911	226, 229, 045
Value	$15, 213, 628	$9, 241	$15, 222, 869	$21, 707, 660	$9, 392	$21, 717, 052
Distributed through city mains:						
Quantity.M cubic feet	102, 275, 282	48, 980, 441	151, 255, 723	104, 592, 472	51, 471, 322	156, 063, 794
Value	$26, 284, 784	$18, 225, 920	$44, 510, 704	$26, 656, 284	$18, 055, 386	$44, 711, 670
Sold for industrial use:						
Quantity.M cubic feet	12, 374, 850	1, 284, 900	13, 659, 750	21, 096, 829	1, 441, 755	22, 538, 584
Value	$1, 287, 057	$394, 047	$1, 681, 104	$2, 204, 768	$433, 011	$2, 637, 779
Tar:						
Production.....gallons	403, 300, 674	47, 007, 153	450, 307, 827	510, 765, 616	49, 619, 962	560, 385, 578
Sales:						
Quantity.....do	262, 884, 814	45, 821, 105	308, 705, 919	309, 380, 205	48, 802, 554	358, 182, 759
Value	$10, 755, 920	$1, 841, 785	$12, 597, 705	$13, 236, 605	$2, 091, 735	$15, 328, 340
Average value	$0. 041	$0. 040	$0. 041	$0. 043	$0. 043	$0. 043
Ammonia:						
Production (NH_3 equivalent of all forms) pounds	249, 206, 321	23, 449, 563	272, 655, 884	320, 861, 321	26, 309, 324	347, 170, 645
Liquor (NH_3 content):						
Production.....pounds	37, 445, 171	4, 332, 404	41, 777, 575	42, 707, 324	4, 551, 921	47, 259, 245
Sales.....do	38, 850, 459	4, 247, 444	43, 097, 903	42, 315, 907	4, 591, 330	46, 907, 237
Value	$1, 162, 831	$90, 350	$1, 253, 181	$1, 238, 752	$90, 036	$1, 328, 788
Sulphate:						
Production.....pounds	847, 044, 599	76, 468, 636	923, 513, 235	1,112,615,989	87, 029, 614	1,199,645,603
Sales.....do	895, 493, 472	89, 817, 359	985, 310, 831	1,044,424,839	78, 918, 228	1, 123, 343, 067
Value	$8, 516, 782	$833, 151	$9, 349, 933	$10, 653, 237	$830, 954	$11, 484, 191
Crude light oil:						
Production.....gallons	129, 863, 851	3, 832, 952	133, 696, 803	166, 275, 705	3, 958, 497	170, 234, 202
Sales.....do	9, 223, 127	2, 852, 903	12, 076, 030	7, 483, 501	2, 879, 675	10, 363, 176
Value	$778, 875	$238, 453	$1, 017, 328	$722, 799	$248, 965	$971, 764
Light-oil derivatives:						
Production.....gallons	106, 790, 440	749, 975	107, 540, 415	140, 137, 380	834, 854	140, 972, 234
Sales.....do	103, 280, 930	774, 731	104, 055, 661	135, 476, 381	817, 948	136, 294, 329
Value	$13, 577, 040	$116, 809	$13, 693, 849	$17, 845, 767	$121, 246	$17, 967, 013
Naphthalene, crude and refined:						
Production.....pounds	12, 933, 257	4, 020	12, 937, 277	37, 395, 607	156, 612	37, 552, 219
Sales.....do	13, 210, 088	4, 020	13, 214, 108	34, 793, 228	153, 662	34, 946, 890
Value	$167, 572	$60	$167, 632	$567, 549	$2, 746	$570, 295
All other products, value	$1, 041, 004	$74, 348	$1, 115, 352	$1, 655, 909	$68, 363	$1, 724, 272

[1] Includes all byproduct ovens built by city gas companies, some of which are operated in conjunction with coal-, oil-, and water-gas plants. Does not include independent byproduct plants, which may sell gas to public utility companies for distribution.

RECENT DEVELOPMENTS IN COAL PREPARATION AND UTILIZATION

By Arno C. Fieldner

SUMMARY OUTLINE

The first annual review of this series (Minerals Yearbook 1932–33, pp. 433–445) presented the background for the new developments discussed in the subsequent years. Readers unfamiliar with the subject will find it helpful to read this initial review and those following in subsequent yearbooks.

The steady progress of coal research in the United States during 1936 is one of the gratifying features of the uplift from the depths of the depression. Fundamental and applied research in coal technology is now being conducted at a number of centers. Bituminous Coal Research, Inc., reports some 40 laboratories as engaged to some degree in research on coal and coal utilization.[1] At least 10 of these laboratories may be considered major contributors to our knowledge of coal and advances in coal technology. This is a good start, but much remains to be done, as indicated by the report of the Committee on Bituminous Research Planning.[2]

COMPOSITION, PROPERTIES, AND TESTING

Approval of the Tentative American Standard for classification of coal according to rank and grade [3] has provided authoritative boundary lines between anthracite, semianthracite, low-, medium-, and

[1] Bituminous Coal Research, Inc. (Southern Bldg., Washington, D. C.), Résumé of Current Research in Coal and Coal Utilization: December 1936, 37 pp.

[2] Coal Division, Am. Inst. Min. and Met. Eng., Bituminous-Coal Research: 1936, 85 pp., 21 graphs.

[3] American Society for Testing Materials, Tentative Specifications for Classification of Coals by Rank, A. S. A. M20.1-1936; A. S. T. M. D388-36T: Proc. Am. Soc. Test. Mat., pt I, vol. 36, 1936, pp. 812-818. Tentative Specifications for Clssification of Coals by Grade, A. S. A. M20.2-1936; A. S. T. M. D389-34T: Proc. Am. Soc. Test. Mat., pt. I, vol. 34, 1934, pp. 841-842. Fieldner, A. C., American Standard Sets Up Common Language for Coal: Industrial Standardization and Commercial Standards Monthly, vol. 7, 1936, pp. 273-278. Harris, T. W., Jr., Coal Classification—How It Can Be Used in Purchasing: Industrial Standardization and Commercial Standards Monthly, vol. 7, 1936, pp. 175-178.

high-volatile bituminous coals, subbituminous coal, and lignite. Investigations on progressive changes in the properties of coal in relation to rank have shown that the amount of moisture retained [4] by typical banded coals, after drying under standardized conditions (25° C. with air of 50 percent relative humidity), and the ease of chemical oxidation [5] of the coals, as measured by standard potassium permanganate consumed, increases while the angle of polarization [6] of light reflected from polished surfaces of vitrain decreases.

Several publications giving analyses, petrographic composition, and carbonizing properties of North American coals [7] and W. A. Bone's comprehensive revision [8] of his pioneering book on the constitution and uses of coal were issued in the past year. Hoffmann [9] has attempted to correlate the various systems of nomenclature used in coal petrography. Microscopical studies by other investigators have shown that vitrain (anthraxylon) tends to go into the smaller sizes of coal [10] and fusain concentrates in the fine dust.[11] In several instances, the fusain contained considerably more phosphorus than the associated coals.[12] Examination of the splint coals of the Upper and Lower Cedar Grove beds of West Virginia indicated that the granular opaque matter which characterizes thin sections of splint coals is derived from coniferous wood fibers.[13] Further progress has been made in the correlation of coal beds by identification of spores [14] and in the "float-and-sink" separation of the banded constituents of coal beds.[15] About 1 percent germanium has been found in the ash of several Donetz coals.[16]

Chemical constitution.—The Coal Research Laboratory of the Carnegie Institute of Technology continued its study of the constitution of coal by extracting with solvents [17] and chlorination [18] of a

---

4 South Metropolitan Gas Co., The Moisture Content of Coal and Its Relation to Some Other Properties: Gas Jour., vol. 213, 1936, pp. 822–824.

5 Olin, H. L., and Waterman, W. W., Rank of Coals as Indicated by Oxygen Absorption: Ind. and Eng Chem., vol. 28, 1936, pp. 1024–1025. Olin, H. L., and others, Iowa Coal Studies: Iowa Geol. Survey Tech. Paper 3, 1936, 80 pp.

6 McCabe, L. C., and Quirke, T. T., Angle of Polarization as an Index of Coal Rank: Am. Inst. Min. and Met. Eng. Tech. Pub. 791, 1936, 11 pp.

7 See footnote 5. Bureau of Mines, Analyses of New Mexico Coals: Tech. Paper 569, 1936, 112 pp. Jones, I. W., Microscopic Features of Certain Alberta Coals: Canadian Jour. Research, vol. 14, B, 1936, pp. 275–298. Thiessen, R., and Sprunk, G. C., Origin and Petrographic Composition of the Lower Sunnyside Coal of Utah: Tech. Paper 573, Bureau of Mines, 1937, 34 pp. Fieldner, A. C., Davis, J. D., Thiessen, R., Selvig, W. A., Reynolds, D. A., Jung, F. W., and Sprunk, G. C., Carbonizing Properties and Petrographic Composition of Clintwood Bed Coal from Buchanan Mines Nos. 1 and 2, Buchanan County, Va.: Tech. Paper 570, Bureau of Mines, 1936. 34 pp. Fieldner, A. C., Davis, J. D., Thiessen, R., Selvig, W. A., Reynolds, D. A., Sprunk, G. C., and Jung, F. W., Carbonizing Properties and Petrographic Composition of Pittsburgh Bed Coal From Pittsburgh Terminal No. 9 Mine, Washington County, Pa.: Tech. Paper 571, Bureau of Mines, 1936, 33 pp. Fieldner, A. C., Davis, J. D., Thiessen, R., Selvig, W. A., Reynolds, D. A., Sprunk, G. C., and Holmes, C. R., Carbonizing Properties and Petrographic Composition of Millers Creek Bed Coal from Consolidation No. 155 Mine, Johnson County, Ky., and the Effect of Blending Millers Creek Coal with Pocahontas Bed and Pittsburgh Bed (Warden Mine) Coals: Tech. Paper 572, Bureau of Mines, 1937, 50 pp.

8 Bone, W. A., and Himus, G. W., Coal: Its Constitution and Uses (with Supplementary Chapter on Fuel Economy and Heat Transmission in Industrial Furnaces by R. J. Sarjant): Longmans, Green, & Co., Ltd., London, 1936, 631 pp.

9 Hoffmann, E., Nomenclature and Appearance of the Constituents in Bituminous Coal Petrography: Brennstoff-Chem., vol. 17, 1936, pp. 341–351.

10 McCabe, L. C., Concentration of the Banded Ingredients of Illinois Coals by Screen Sizing and Washing: Am. Inst. Min. and Met. Eng. Tech. Pub. 684, 1936, 11 pp.

11 Thiessen, G., Fusain Content of Coal Dust From an Illinois Dedusting Plant: Am. Inst. Min. and Met. Eng. Tech. Pub. 664, 1936, 12 pp.

12 See also footnote 11. Edwards, A. H., and Jones, J. H., Note on the Occurrence of Phosphorus in Fusain: Chem. and Ind., vol. 55, 1936, pp. 186T–189T.

13 Thiessen, R., and Sprunk, G. C., The Origin of the Finely Divided or Granular Opaque Matter in Splint Coals: Fuel, vol. 15, 1936, pp. 304–315.

14 Paget, R. F., The Correlation of Coal Seams by Microspore Analysis: the Seams of Warwickshire: Trans. Inst. Min. Eng., vol. 92, part 2, 1936, pp. 59–88.

15 Berry, H., and Jones, J. H., Physical and Chemical Survey of the National Coal Resources. The Fractional Gravity Separation of the Banded Constituents of Coal: Fuel, vol. 15, 1936, pp. 343–351.

16 Zil'bermintz, V. A., Germanium in the Coals of the Donetz Basin: Mineral. Suir'e, vol. 11, no. 6, 1936, pp. 16–26; Chem. Abst., vol. 30, 1936, p. 7306.

17 Asbury, R. S., Action of Solvents on Coal. Extraction of a Pittsburgh Seam Coal With Aniline, Tetralin, and Phenol at Elevated Temperatures: Ind. and Eng. Chem., vol. 28, 1936, pp. 687–690.

18 Weiler, J. F., Exhaustive Chlorination of a Bituminous Coal: Jour. Am. Chem. Soc., vol. 58, 1936, pp. 1112–1114

Pittsburgh bed coal; the close agreement between the properties of corresponding products of the benzene-pressure extract[19] and the residue,[20] and of the hydrogenation products[21] of extract and residue, indicates that these materials are very similar in their essential chemical structure; and it was concluded that the coal structure is made up of fundamental units with an average molecular weight of about 300, held together in larger aggregates by some relatively weak type of linkage.[22] These aggregates can be depolymerized or peptized and put into colloidal solution by the action of benzene, quinoline, aniline, anthracene, or certain heavy oils heated under pressure to temperatures well above their boiling points.[23] Such solutions are especially suitable for the production of synthetic gasoline by the hydrogenation process. The various so-called "colloidal fuels"[24] are stable suspensions of finely powdered coal in oil rather than colloidal solutions. Russian chemists have identified thioether sulphur as one of the organic sulphur compounds in coal.[25]

Gas evolution in coal mines.—Mine-air samples taken automatically at 1-hour intervals over 24-hour periods in a number of Belgian mines showed that methane was evolved not only from the face but from fissures behind the face and from the waste. Some seams yielded no methane, whereas others gave off 6,000 cubic feet of methane per ton of coal mined.[26] Breyre believes that these large amounts are difficult to explain on the hypothesis of adsorption by the coal, and Audibert,[27] on the basis of experimentally determined sorption isotherms of methane in coal at 4° C. and up to 150 atmospheres pressure, concludes that practically all the methane contained in coal is dissolved rather than adsorbed. (See Bureau of Mines Report of Investigations 3233, The Occurrence of Gases in Coals, by R. F. Selden, 1934, 64 pp.) Hoffmann[28] found that the amount of methane evolved from boreholes decreased with descending rank of coal, and that the amount was greater for dull coal than bright coal in high-rank coals and the reverse in low-rank coals. Leprince-Ringuet[29] has summarized recent researches, and others[30] have discussed carbon dioxide and methane outbursts.

[19] Biggs, B. S., The Chemical Nature of Extracts from a Bituminous Coal: Jour. Am. Chem. Soc., vol. 58, 1936, pp. 484–487.

[20] Biggs, B. S., The Relation of Extract to Residue in a Bituminous Coal: Jour. Am. Chem. Soc., vol. 58, 1936, pp. 1020–1024.

[21] Biggs, B. S., and Weiler, J. F., The Chemical Constitution of a Bituminous Coal as Revealed by its Hydrogenation Products: Jour. Am. Chem. Soc., vol. 59, 1937, pp. 369–372.

[22] Smith, R. C., and Howard, H. C., Molecular Weights of Polymeric Substances in Catechol and their Bearing on the Nature of Coal and Derived Products: Jour. Am. Chem. Soc., vol. 58, 1936. pp. 740–742.

[23] Gillet, A., and Pirlot, A., The Complete Solution in Benzene of the Fundamental Matter of a Coal: Fuel, vol. 15, 1936, pp. 124–127. Gillet, A., Pirlot, A., and Desirotte, L., Study of the Disintegration of Coal in Solvent Between 200° and 400°. X. Stabilizing Action of Fatty Acids: 15th Cong. Chim. Ind., Brussels, September 1935, pp. 267C–275C. Gillet, A., The Solution of Bituminous Coal in Heavy Oils: Brennstoff-Chem., vol. 17, 1936, pp. 421–429. Agde, G., and Hubertus, R., Investigation of the Colloidal Structure of Bituminous Coals: Braunkohlenarchiv., no. 46, 1936, pp. 3–30.

[24] Brownlie, D., Colloidal Fuel. Description of Different Processes: Ind. and Eng. Chem., vol. 28, 1936, pp. 839–842. (An excellent review.) Strevens, J. L., Colloidal Fuel: Coll. Eng., vol. 13, 1936, pp. 124–126, 200–202, 275–277. Schuster, F., Coal-in-Oil: Kolloid-Ztschr., vol. 75, 1936, pp. 125–128. Buchholz, Erich, Experiments on the Preparation of Flow Coal from Lignite Dust and Lignite Tar Oil: Angew. Chem., vol. 49, 1936, pp. 307–310.

[25] Postowsky, J. J., and Harlampovich, A. B., The Presence of Thioether Sulphur in Organically Fixed Sulphur of Coals: Fuel, vol. 15, 1936, pp. 229–232.

[26] Breyre, Adolphe, The Evolution of Firedamp in Belgian Coal Mines: Fuel, vol. 15, 1936, pp. 253–257.

[27] Audibert, Etienne, The Deposition of Methane in Coal: Coll. Guard., vol. 153, 1936, pp. 767–770; vol. 8, 1935, pp. 225–256; Rev. ind. minérale, no. 372, 1936. pp. 662–673.

[28] Hoffmann, E., Dependence of Gas Liberation on the Petrographic Constitution and Degree of Coalification in the Case of the Ruhr Coals: Glückauf, vol. 71, 1935, pp. 997–1005.

[29] Leprince-Ringuet, Félix, Liberation of Methane and Other Natural Gases in Mines: Rev. ind. minérale, no. 363, 1936, pp. 113–138.

[30] Stutzer, O., Carbon Dioxide Eruptions from Coal Seams in Lower Silesia: Econ. Geol., vol. 31, 1936, pp. 441–452. Roblings, G., Outbursts of Gas: Supplement to the Coll. Guard., vol. 153, November 1936, pp. 13–16.

Spontaneous ignition and effect of low-temperature oxidation.—A Bureau of Mines investigation of the causes of anthracite mine fires found a direct correlation between the spontaneous ignitability of carbonaceous matter and the rate of carbon monoxide formation when the sample was heated in a stream of air.[31] Studies of the oxidation mechanism and peroxide formation of two hydrocarbons which are components of tars and oils showed that the determination of double bonds in a fuel by means of the bromine or iodine number is not necessarily a measure of self-ignitability.[32] For a given bituminous coal, allowed to heat spontaneously in an oxygen atmosphere,[33] it was found that both the rate of oxygen adsorption and temperature rise were nearly linear functions of time, therefore, one may be predicted from the other with considerable accuracy. Mild oxidation of Pittsburgh bed coal [34] was found to increase the strength of coke and to decrease the yield of tar very appreciably, long before any changes could be detected in proximate and ultimate analyses, heating value, and agglutinating value. The amount and rate of oxidation increased with descending rank of the coal, and fresh coal oxidized more rapidly than stored coal.[35] Treatment of coking coals with oxygen at higher temperatures, up to 300° C., increased the rate of oxidation and the amounts of carbon monoxide, carbon dioxide, and water formed but decreased the amount of oxygen fixed in the coal.[36]

Plasticity and coking properties.—Measurement of the plastic properties of coal and their relation to coke formation have received considerable attention.[37] From observed characteristics of the "transient" fusion of coal, together with its agglutinating index with sand, when coked under specified conditions, Gillet [38] claims a satisfactory means of predicting the mechanical properties of the coke to be expected in practice. Agde and Hubertus postulated from numerous extraction and microscopic studies that the colloidal structure of bituminous coal causes plasticity, swelling, and caking.[39]

Comparison by the Bureau of Mines of the Davis plastometer, Agde-Damm dilatometer, and the Layng-Hathorne gas-flow methods show that the plastometer gives the best data for the plastic range and the dilatometer for the preplastic period. A fairly good prediction of coke quality may be made from the plastometer results.[40] Others report that dilatometer methods correlate well with the behavior of coals on both low- and high-temperature carbonization.[41]

---

[31] Scott, G. S., and Jones, G. W., Oxidation of Anthracite—Liberation of Carbon Monoxide and Its Relation to Ignition Temperature: Ind. and Eng. Chem., vol. 29, 1937, pp. 106–108.

[32] Hock, H., and Schrader, O., The Mechanism of Auto-oxidation of Simpler Hydrocarbons as a Contribution to the Knowledge of Auto-oxidation of Fuel (paper presented before the German Chem. Soc. meeting, Munich, July 7–11, 1936): Brennstoff-Chem., vol. 17, 1936, p. 312.

[33] Weinrich, W., and Gaspari, H., An Adiabatic Calorimeter: Ind. and Eng. Chem., Anal. Ed., vol. 8, 1936, pp. 307–310.

[34] Schmidt, L. D., Elder, J. L., and Davis, J. D., Oxidation of Coal at Storage Temperatures—Effect on Carbonizing Properties: Ind. and Eng. Chem., vol. 28, 1936, pp. 1346–1353.

[35] Stansfield, E., Lang, W. A., and Gilbart, K. C., The Oxidizability of Coal: Fuel, vol. 15, 1936, pp. 12–14.

[36] Lefebvre, H., and Faivre, R., Oxidation of Coal: Compt. rend., vol. 203, 1936, pp. 881–883.

[37] Simomura, A., and Simomura, K., Caking Coals in Karafuto: Jour. Fuel Soc. Japan, vol. 15, 1936, pp. 26–28. Cummings, G. T., and Ivison, N. J., A Simple Method for the Determination of the Swelling of Coals: Fuel, vol. 15, 1936, pp. 162–164. Swietoslawski, W., Physicochemical Analysis of the Coking Reaction: 15th Cong. Chim. Ind., Brussels, September 1935, pp. 468C–469C.

[38] Gillet, Alfred, Mechanical Properties of Coke and Present-Day Investigations of the Transient Fusion of Soft Coals: Rev. universelle mines, vol. 12, 1936, pp. 269–281.

[39] Agde, G., and Hubertus, R., Investigations on the Colloidal Structure of Coal: Braunkohlenarchiv., no. 46, 1936, pp. 3–30. Colloid Structure of Coal as a Cause of Plasticity, Swelling and Caking of Coking Coals: Brennstoff-Chem., vol. 17, 1936, pp. 149–150.

[40] Brewer, R. E., and Atkinson, R. G., Plasticity of Coals– Its Measurement and Relation to Quality of Coke Produced: Ind. and Eng. Chem., Anal. Ed., vol. 8, 1936, pp. 443-449

[41] Cassan, H., Note on the Swelling of Gas and Coking Coals: Jour. usines gaz., vol. 60, 1936, pp. 145–157. Chemical department of the South Metropolitan Gas Co., Measurement of the Swelling Properties of Coal: Fuel, vol. 15, 1936, pp. 36–39. Arnu, Carles, Practical Method for the Dilatometric Testing of Coking Coals: 15th Cong. Chim. Ind., Brussels, September 1935, pp. 628C–634C. Chandesris, René, Coals of the Saar Basin: Rev. ind. minérale, no. 361, 1936, pp. 1–20; no. 365, 1936, pp. 243–278.

Weathering, admixture of inerts, and variation of rate of heating produces a greater effect on the swelling, plasticity, and rate of decomposition of poorly coking coals than on good-coking coals.[42] The best cokes are produced from those coking coals which give off the largest amount of gas throughout the plastic range.[43] Poor coke may be caused by: (*a*) A large percentage of volatile matter at the end of the plastic range, and (*b*) a deficiency of plastic material to bind the coal particles sufficiently to give a nonabradable coke.[44]

Ash fusion and clinkering.—Although the direct determination [45] of ash-softening temperature is cheaper and more accurate than estimation from ash analysis, investigators continue to obtain data on the relation between the composition of ash and its fusibility.[46] Combustion tests of anthracite in furnace equipment indicated that ash-softening temperatures corresponding to various degrees of clinker formation were, respectively: 3,000° F., none; 2,810° F., small; 2,450°–2,550° F., bad.[47] Ash-softening temperatures are functions of compositions in terms of alumina, silica, lime, and ferric oxide on a sulphur trioxide-free basis. These are derived from detrital clay, kaolinite, calcite, and pyrite, as shown by petrographic examination of the separable mineral matter from Illinois and western Pennsylvania coals.[48]

Different types of refractories have been found to have the following relative order of resistance to erosion by coal-ash slags: Forsterite, silica, chromite, magnesia, high alumina (diaspore type), high alumina (electrically fused type), high mullite (bonded type), cast mullite, and silicon carbide, no erosion occurring until the temperature of the refractory face exceeds the ash-softening temperature.[49] The DeGraaf micropyrometer method has been modified so as to furnish a permanent photographic record of the changes in the coal ash during the fusion interval.[50]

Sampling.—Mechanical methods for the collection of gross samples and their reduction [51] to laboratory size are being more widely used and application of the theory of probability to coal sampling is resulting in a better understanding and interpretation of sampling problems [52] and laboratory analyses.

[42] Mott. R. A., and Spooner, C. E., Studies in Coke Formation—XIII. The Swelling Power of Coal: Fuel, vol. 16, 1937, pp. 4–14. Koopmans, H., and Pieters, H. A. J., Some Characteristic Properties of Coking Coals. Fuel, vol. 15, 1936, pp. 40–42. Pieters, H. A. J., Koopmans, H., and Hovers, J., The Mechanism of Coking and the Characteristic Properties of Coking Coal: Cong. Internat. Mines Met. Geol. Appl., 7th Sess., Paris, October 1935, Mines Sec., vol. 2, pp. 496–506; Rev. ind. minérale, no. 376, 1936, pp. 880–890. The Carbonization of Vitrains and Their Mxitures: Fuel, vol. 15, 1936, pp. 43–47.

[43] Schuster, Fritz, Chemistry and Physics of Coal: Chem.-Zeit., vol. 60, 1936, pp. 513–515.

[44] Davidson, W., Coke Research: Jour. West Scotland Iron Steel Inst., vol. 43, 1936, pp. 117–128.

[45] Pieters, H. A. J., Determination of the Melting Point of Coal Ash: Chem. Weekblad, vol. 33, 1936, pp. 519–520; Chem. Abs., vol. 30, 1936, p. 8566. Hall, G. E., and Hodsman, H. J., Apparatus for Determining the Fusibility of Coal Ash: Chem. and Ind., vol. 55, 1936, pp. 151–152T.

[46] Kosaka, Y., Toda, H., and Kitagawa, O., Studies on the Fusibility of Coal Ash. V. Relation Between the Chemical Composition and the Fusibility of Japanese Coal Ashes. VI. Relations Between the Fusibility and Certain Characteristics of Japanese Coal Ash: Jour. Soc. Chem. Ind., Japan, vol. 39, 1936, pp. 36B–40B; Chem. Abs., vol. 30, 1936, p. 3966. Holmes, C. W. H., Coal Ash and Clinker: Coll. Eng., vol. 13, 1936, pp. 3–8. See also footnotes 47 and 48.

[47] Jones, D. J., and Buller, E. L., Analyses and Softening Temperatures of Coal Ash from Coals in the Northern Anthracite Field: Ind. and Eng. Chem., Anal. Ed., vol. 8, 1936, pp. 25–27.

[48] Thiessen, G., Ball, C. G., and Grotts, P. E., Coal Ash and Coal Mineral Matter: Ind. and Eng. Chem., vol. 28, 1936, pp. 355–361.

[49] Fettke, C. R., and Stewart, W. E., The Slagging Action of Western Pennsylvania Coals on Different Types of Refractories in a Small Pulverized-Coal Installation: Mining and Metallurgical Investigations, Mining and Metallurgical Advisory Boards, Carnegie Inst. Technol. Bull. 73, 1936, 84 pp.

[50] Brennan, J. J., Mitchell, D. F., Tierney, F. P., and Thompson, W. C., The Fusibility of Coal Ash: Ind. and Eng. Chem., Anal. Ed., vol. 9, 1937, pp. 106–111.

[51] Dawe, A., and Potter, N. M., The Sampling of Coal in the Laboratory With the "Cascade" Sampler: Fuel, vol. 15, 1936, pp. 128–136.

[52] Grumell, E. S., and Dunningham, A. C., The Sampling of Small Coal: Fuel, vol. 15, 1936, pp. 55–59. Guy, T. W., A Control Chart for Interpretation of Coal-Sampling Data: Combustion, vol. 7, December 1935, pp. 28–32; Fuel, vol. 15, 1936, pp. 100–109. Younkins, J. A., Notes on the Collection and Reduction of Coal Samples: Mineral Industries, Pennsylvania State College, vol. 6, September 1936, pp. 3–4; and October 1936, p. 2; Colliery Engineering, vol. 13, 1936, pp. 427–428. Holmes, C. W. H., Variables in a Raw Slack: Coll. Eng., vol. 13, 1936, pp. 161–164. Holmes, M. C., and Downs, R., Further Notes on Sampling Analysis, With Application to Coal: Jour. Franklin Inst., vol. 222, 1936, pp. 337–343

Testing methods.—The American Society for Testing Materials [53] and the British Standards Institution [54] have published standard methods for sampling and analyzing coal. The British Fuel Research Station has developed some new formulas for computing "pure" coal analyses,[55] and German investigators have studied the effect of fusion temperature on ash determinations.[56]

PREPARATION

Increased stripping and mechanical loading activities and more exacting market requirements necessitated further expansion of mechanical cleaning facilities despite further improvement in preparation at the face.[57] [58] [59] [60] [61] A new plant for recovering pyrite and coal from coal-washery refuse, employing ore jigs and concentrating tables, with a capacity of 75 tons of feed per hour, was put into operation at Mineral, Kans. About one-third of the waste from picking tables at Illinois mines can be recovered as marketable coal,[62] and a central Baum-type jig washery has been erected near Kincaid, Ill., to recover coal and pyrite from picking-table refuse produced at four nearby mines.[63] Differences in electrical conductivity and reflecting power of light of coal and refuse are being tried as substitutes for hand picking.[64] [65] Drained high-ash washery sludge, containing 18 percent moisture [66] and dry dust [67] from dedusting plants, is used for generating power at mines in Indiana and Illinois. Experimental work in England indicates that the size composition of slack coal, and even of crushed coal, follows the Rosin-Rammler law of size distribution. By means of this law, it is possible to express the size distribution of coal by two numbers instead of the many required in the conventional method of reporting screen analyses.[68]

---

[53] American Society for Testing Materials, Standards on Coal and Coke: Am. Soc. Test. Mat. (Philadelphia, Pa.), September 1936, 143 pp.

[54] Standard Methods for the Analysis of Coal Ash and Coke Ash: British Standard Specifications No. 686, 1936. Standard Methods for Ultimate Analysis of Coal and Coke; British Standard Specifications No. 687, 1936. Standard Method for the Determination of the Agglutinating Value of Coal: British Standard Specifications No. 705, 1936.

[55] King, J. G., Maries, M. B., and Crossley, H. E., Formulae for the Calculation of Coal Analyses to a Basis of Coal Substance Free From Mineral Matter: Chem. and Ind. vol. 55, 1936, pp. 277T–281T.

[56] Holthaus, C., Critical Investigations of Ash Analyses in Bituminous Coals: Arch. Eisenhüttenw., vol. 9, 1935–36, pp. 369–388; Chem. Abs., vol. 30, 1936, p. 3203. Rosin, P., Rammler, E., and Kauffmann, J. H., The Dependence of the Ash Content of Fuels on Temperature: Arch. Wärmewirt., vol. 17, 1936, pp. 13–16; Chem. Abs., vol. 30, 1936, p. 7815.

[57] Plein, L. N., Statistical Analysis of the Progress in Mechanical Cleaning of Bituminous Coal from 1927 to 1934: Econ. Paper 18, Bureau of Mines, 1936, 25 pp.

[58] Officer, C. B., Multicutting in Coal Mining: Min. Cong. Jour., vol. 22, July 1936, pp. 37–38. Johnson, E. H., What Shearing Accomplishes in Mechanical Loading: Min. Cong. Jour., vol. 22, July 1936, pp. 38–39.

[59] Coal Age, Bituminous Preparation Registers Gains in Capacity and Methods: Vol. 42, 1937, pp. 69–72. Anthracite Industry Presses Drive on Costs and Product: Vol. 42, 1937, pp. 53–56. Hebley, H. F., New Coal-Preparation Equipment Makes Quality Products Possible: Min. and Met., vol. 18, 1937, pp. 43–44. Alford, Newell G., Bibliography of Coal Cleaning, Jan. 1, 1934, to Mar. 31, 1935: 1935 Year Book, Coal Mine Mechanization, Am. Min. Cong., pp. 276–280. Reynolds, Wm., Jr., Cleaning Bituminous Coal While Cutting: Am. Inst. Min. and Met. Eng. Tech. Pub. 739, 1936, 10 pp.

[60] Plein, L. N., and Tryon, F. G., Sales of Mechanical Loading and Cleaning Equipment for Use in Coal Mines in 1936: Min. Cong. Jour., vol. 23, February 1937, pp. 57–60.

[61] McMillan, E. R., New Central Coal-Cleaning Plant of Northwestern Improvement Co.: 1936 Year Book, Coal Mine Mechanization, Am. Min. Cong., pp. 248–256. Beddow, W. W., Air-Sand Process and New Sizing Facilities Installed at Logan County Coal Corporation Plant: Coal Age, vol. 41, 1936, pp. 139–144. Weimer, E. J., The Marion-Vissac Coal Jig: 1936 Year Book, Coal Mine Mechanization, Am. Min. Cong., pp. 243–244. Given, I. A., Lump Broken Down and All Sizes Mechanically Cleaned at Talleydale Preparation Plant: Coal Age, vol. 41, 1936, pp. 500–504.

[62] Smith, C. M., and Mitchell, D. R., Possible Recovery of Coal from Waste at Illinois Mines: Univ. of Illinois Eng. Exp. Station, Bull. 285, 1936, 42 pp.

[63] Verhoeff, J. R., Coal-Processing Plant of Peabody Coal Co.: 1936 Year Book, Coal Mine Mechanization, Am. Min. Cong., pp. 260–268.

[64] Colliery Guardian, The Birtley Electric Picker: Vol. 154, 1937, pp. 16–17. Appleyard, K. C., Flint, B., and Flint, A., Separation of Coal and the Like: U. S. Patent 2065205, Dec. 22, 1936.

[65] Wöhlbier, H., Theory of Photo-Electric Cells and Their Possible Applications in Mining in Germany: Kohle und Erz., vol. 33, 1936, pp. 155–164.

[66] Sherwood, R. H., Power-Plant Operation: 1936 Year Book, Coal Mine Mechanization, Am. Min. Cong., pp. 202–203.

[67] Coal Age, Sealing, Safety Gains, Power Plants, and Cleaning—HighspotIndiana Meeting: Vol. 42, 1937, pp. 37–39.

[68] Bennett, J. G., Broken Coal: Jour. Inst. Fuel, vol. 10, 1936, pp. 22–39; Coll. Guard., vol. 153, 1936, pp. 945–948, 993–996, 1053–1055.

Dedusting, dewatering, and drying.—At the new cleaning plant of the Bell & Zoller Coal Mining Co., near Zeigler, Ill., which has a capacity of 1,000 tons per hour and uses the sand-flotation cone for coarse coal and pneumatic launder-flow tables for fine coal, the dust is removed during the latter operation and shipped separately or in combination with other sizes. The Pittsburgh Coal Co. dedusts through ⅜-inch pulverizer coal by aspiration after washing and heat drying. The Chicago, Wilmington & Franklin Coal Co. also dedusts pneumatically at 48 mesh and ships this product separately or in combination with other sizes. Dedusting is also being done wet by means of sprays on vibrating screens.

The Willow Grove No. 10 cleaning plant of the Hanna Coal Co. (Neffs, Ohio), the Delta Coal Mining Co. (Carrier Mills, Ill.), and the Roslyn-Cascade Coal Co. (Ronald, Wash.), among others, installed rotary-kiln-type heat-drying plants. The first two installations, although of the common rotary-kiln type, admit the hot gases through louvers around the periphery of the shell. A drier of similar design has been used previously in Sweden for drying charcoal.

In Germany a Government commission reviewed the physical and technical problems encountered in drying coal as bearing on the processes of briquetting, carbonization, hydrogenation, and pulverization.[69] The Fleissner process for dehydrating lignite by heating with steam under pressure is being used in Germany and Austria.[70]

Flocculation and settlement of solids in washery water.—One American washery is using lime and another is using amylaceous materials as flocculating agents to increase the rate of clarification of washery water. Although coal slurries contain very little material of colloidal dimensions, flocculation may be brought about by lyophilic colloid-type flocculators such as starch and glue, but not by electrolytes. Certain slurries not amenable to such flocculents can be made amenable by prior treatment with very small quantities of wetting agents.[71] Numerous patented flocculating agents are being marketed in England, and considerable research on this problem is being carried out in England [72] and in Germany.[73]

Dust-prevention treatment.—Rapid growth occurred in the practice of treating coal with oil, calcium chloride, and other agents to render it dustless.[74] Experiments in the firing of coals sprayed with oils

[69] Springer, Julius, The Drying and Dewatering of Coal: Report of the Reichskohlenrat, Berlin, 1936, 80 pp. Thau, A., Drying and Dewatering of Coal: Feuerungstechnik, vol. 24, 1936, pp. 108–111. Rosin, P. O., and Rammler, E., Contribution to the Drying of Coal: Jour. Inst. Fuel, vol. 9, 1936, pp. 363–373; Fuel Economist, The Drying of Washed Coal: Vol. 11, 1936, pp. 279–283.

[70] Westermeier, B., Drying Lignitic Brown Coal: Rodsch. Tech. Arbeit., vol. 20, 1936, pp. 1–2; Skutl, V., The Processes Occurring During the Heating of Lignitic Coals by Steam under Pressure for Coal Drying: Berg- u. Hüttenmänn. Jahrb. Montan. Hochschule Leoben, vol. 84, 1936, pp. 13–38.

[71] Department of Scientific and Industrial Research, Fuel Research Board Report: H. M. S. Office, London, Mar. 31, 1936, p. 70.

[72] Needham, L. W., Treatment of Washery Water. Practical Aspects of Flocculation: Coll. Guard., vol. 153, 1936, pp. 191–197. Samuel, J. O., Some Aspects of Flocculation: Chem. and Ind., vol. 55, 1936, pp. 669–680. Powell, Roger F., Some Comments Suggested by the Paper "Some Aspects of Flocculation", by J. O. Samuel: Chem. and Ind., vol. 55, 1936, pp. 998–1001. Colliery Engineering, Flocculation in Theory and Practice (A General Survey): Vol. 13, 1936, pp. 45–52. Samuel, J. O., and Unifloc Reagents, Ltd., Improvements in or Relating to the Separation from Liquids of the Particles Dispersed or Suspended Therein: British Patent 450032, July 9, 1936. Vohmann, F., and Trümpelmann, E., Process and Apparatus for Clarifying Coal Slurry and the Like: U. S. Patent 2069024, Jan. 26, 1937.

[73] Lohmann, G., Experiments on the Improvement of Slurry Clarification: Glückauf, vol. 72, 1936, pp. 1121–1133. Götte, A., Investigations of the Filterability of Coal Slurries and Flotation Concentrates: Glückauf, vol. 71, 1935, pp. 1097–1100. van Ahlen, A., Removal of Clay from Coal Slurries by Flotation: Brennstoff-Chem., vol. 17, 1936, pp. 446–451.

[74] West, C. E., Dustless Coal: Proc. Rocky Mountain Coal Min. Inst., 1936, pp. 76–79. Dustproofing Coal Brings Wide Consumer Acceptance in Highly Competitive Domestic Markets: Coal Age, vol. 41, 1936, pp. 229–230. Dustless Coal: Coal Mining, vol. 13, 1936, pp. 9–10. Heiner, Moroni, Treating Coal by the Viking Process at Castle Gate, Utah: Min. Cong. Jour., vol. 22, June 1936, pp. 34–35. Sawens, R. H., Chemical Treatment of Coal to Allay Dust: Min. Cong. Jour., vol. 23, January 1937, pp. 46–47. Roberts, J., Improvements Relating to the Treatment of Fuel by Coloration: British Patent 440402, Dec. 27, 1935. Harris, B. R., Reducing Dustiness of Dusty Materials: U. S. Patent 2068489, Jan. 19, 1937. Schmidt, L. D., Dust-Prevention Treatment of Solid Fuels: Inf. Circ. 6932, Bureau of Mines, 1937, 10 pp.

indicated that ignition is attained more easily but that too much oil decreases air penetration through the fuel bed; efficiency was about 3.9 percent higher with oiled coal. The Interborough Rapid Transit Co. reported that there is no difficulty in grinding oiled coal for pulverized fuel but that no advantage is gained in ordinary firing operations.[75]

Briquetting.—Quite a number of retail coal dealers handling friable, low-volatile coals have installed "packaged-fuel" or other briquetting plants to dispose of fine coal;[76] plants also have been built for anthracite fines,[77] lignite,[78] and bituminous coal.[79] The Piersol process of making low-volatile coal briquets by impact without binder is to be tried on a commercial scale at Collinsville, Ill.[80] In Germany and Austria, the Apfelbeck high-pressure roller press is used for making briquets without binder from brown coal and bituminous coal.[81] Krupp and the Lurgi Co. also have developed a "ring roller" press which subjects the powdered fuel to a pressure of 2,500 atmospheres, making firm briquets without binder. The Canadian Bureau of Mines has published a comprehensive review of history, commercial processes, research, and present status and costs of briquetting in North America.[82]

COMBUSTION

Theoretical studies.—From a mathematical analysis of fuel-bed reactions, Mayers concludes that the coefficient of heat transfer between the solids of the fuel bed and the air or gas stream, the thermal conductivity of the fuel bed, and the specific rate of the combustion reaction appear to depend almost entirely on the physical characteristics of the fuel bed and will be affected more by the size, size distribution, and porosity of the fuel in bulk than by its chemical characteristics. Ignition temperature and possibly coking reactions are the only properties characteristic of a particular fuel that are important in combustion calculations.[83] With the aid of models, Rosin has made extensive studies on the effect of relative motion between fuel, air, and combustion gases on the speed of combustion, both for pulverized coal and for combustion on grates.[84] Here again, physical considerations, such as size of fuel and turbulence of air current were dominating factors in speed of combustion. New methods of determining[85] and interpreting the ignition temperatures of solid fuels have been advanced. Furnas[86] proposes to measure reactivity in terms of the

---

[75] Power, Data on Oil-Sprayed Coal: vol. 80, 1936, p. 383. Combustion, Treated Coal vs. Performance: Vol. 7, May 1936, p. 15.

[76] Newton, W. C., Builds Business with Packaged Fuel: Coal-Heat, vol. 29, April 1936, pp. 18–20. Black Diamond, White Oak Enters the Packaged-Coal Field: Vol. 97, Nov. 7, 1936, p. 18. The Coal Dealer, Packaged Coal Gaining Popularity in Northwest: Vol. 32, April 1936, p. 41. Plein, L. N., and Clark, J. B., Fuel Briquets: Minerals Yearbook, 1936, Bureau of Mines, pp. 658–661. Colliery Guardian, Packaged Fuel: Vol. 153, 1936, p. 108. See also chapter in this volume on Fuel Briquets.

[77] Coal Age, Anthracite Industry Presses Drive on Cost and Product: Vol. 42, 1937, pp. 53–56.

[78] Coal Age, Bituminous Preparation Registers Gains in Capacity and Methods: Vol. 42, 1937, p. 72.

[79] Coal Age, Coal Industry Presses Forward on Economic Front: Vol. 42, 1937, pp. 46–52.

[80] Piersol, R. J., Smokeless Briquets: Illinois State Geol. Survey, Rept. of Investigations 41, 1936, 30 pp.

[81] Iliwitzki, J., The Apfelbeck Briquetting Process: Braunkohle, vol. 35, 1936, pp. 597–600; 618–621. Romberg, H., Binderless Bituminous-Coal Briquetting: Braunkohle, vol. 34, 1935, pp. 617–622.

[82] Strong, R. A., Swartzman, E., and Burrough, E. J., Fuel Briquetting: Canada Dept. Mines and Resources, Bureau of Mines, Publication 775, 1937, 100 pp.

[83] Mayers, Martin A., Some Factors Affecting Combustion in Fuel Beds: Am. Inst. Min. and Met. Eng. Tech. Pub. 771, 1936, 18 pp.

[84] Rosin, P. O., Aerodynamics as a Basis of Modern Fuel Practice: Fuel, vol. 15, 1936, pp. 136–148; Jour. Inst. Fuel, vol. 9, 1936, pp. 287–298.

[85] Roberts, J., A New Method of Determining Ignition Temperatures of Solid Fuels: Gas Jour., vol. 213, 1936, pp. 372–374. Brown, W. S., and Jones, J. H., The Determination of the Ignition Temperature of Coke: Chem. and Ind. vol. 55, 1936, pp. 81T–86T. Speckhardt, G., Reactivity of Coke: Glückauf, vol. 72, 1936, pp. 225–231.

[86] Furnas, C. C., Solid Carbon Reactivity. A New Method of Interpreting Reactivity Data: Ind. and Eng. Chem., vol. 28, 1936, pp. 498–502.

reaction-rate constants for the two equations: $C+O_2=CO_2$ and $CO_2+C=2CO$; Mayers[87] suggests that the results of the measurement of the reactivity of carbonized materials to oxidizing atmospheres over a wide range of temperatures can be reported in terms of the two parameters b and E of the Arrhenius expression for reaction rate. An ingenious method for studying the combustion rate of carbon has been developed which involves the microanalysis of small gas samples withdrawn from the carbon surface inside the "film" overlying the carbon, whereby the variation of gas composition through the film may be determined.[88]

Residential stokers.—Sales of small stokers increased considerably during 1936, and the studies sponsored by Bituminous Coal Research at Battelle Memorial Institute [89] have shown that the two principal characteristics of a coal that determine its performance on small stokers are its caking and coking tendencies and its size range, and these are closely related. Relative total costs of coal, coke, oil, and natural gas, based on tests and survey conducted in Columbus, Ohio, were found to be in the following order: Oil, 177; natural gas, 151; bituminous coal (stoker-fired), 119; bituminous coal (hand-fired), 100; semibituminous coal (hand-fired), 97; coke (hand-fired), 95.[90] The Anthracite Institute Laboratory has developed a new furnace design in which the usual "combustion space" has disappeared, the combustion being complete within the bed of glowing coals. Further application of water-cooled surfaces in the fuel bed for the prevention of clinkers is being studied.[91]

Large power plants.—Improvements in the quality of heat-resisting steel and the purity of feed water have permitted increase of superheated steam temperatures up to 950°–1,000° F., and steam generating pressure up to 2,000 pounds per square inch. Such a plant recently has been completed by the I. G. Farbenindustrie at the Leverkusen works. Pulverized coal is burned under the boilers, and the flue gases are cleaned free from smoke and fly-ash by electrical precipitation. The same effective cleaning of flue gas is done at the new Federal Central Heating Plant, situated adjacent to the fine Government buildings in Washington, D. C.[92] At the new Fulham power station in London, sulphur compounds are removed from the flue gases with a lime treatment. The slag-tap furnaces, which are designed to remove ash as molten slag, are meeting expectations in the United States and are arousing the interest of German engineers.[93] The Trinidad power station of the Texas Light & Power Co. has operated successfully for the past 10 years, using 100-percent lignite in pulverized form. Operating costs are said to have been favorable compared with fuel oil and natural gas during a period when there has

[87] Mayers, Martin A., Methods of Determining the Reactivity of Cokes: Carnegie Inst. Technol. Coal Research Lab. Contrib. 36, 1936, 9 pp.
[88] Parker, A. S., and Hottel, H. C., Combustion Rate of Carbon. Study of Gas-Film Structure by Microsampling: Ind. and Eng. Chem., vol. 28, 1936, pp. 1334–1341.
[89] Sherman, R. A., and Kaiser, E. R., Combustion of Bituminous Coal on the Small Underfeed Stoker: Am. Inst. Min. and Met. Eng. Tech. Pub. 750, 1936, 17 pp.
[90] Sherman, R. A., and Cross, R. C., Efficiencies and Costs of Various Fuels in Domestic Heating: Bituminous Coal Research, Inc., Tech. Report No. 3, 1936, 45 pp.
[91] Johnson, A. J., Furnace Design with Relation to the Prevention of Clinkers: Am. Inst. Min. and Met. Eng., October (1936) meeting.
[92] Barkley, J. F., and Peters, Chas. A., Jr., Equipment and Operating Data on the Federal Central Heating Plant: Combustion, vol. 8, November 1936, pp. 27-32.
[93] Kollbohm, L., Experiences with a Slag-tap Furnace in Germany: Feuerungstechnik, vol. 25, 1937, pp. 5–7. Fehling, R., The Thermodynamic and Technical Fundamentals of Slag-Tap Furnaces: Feuerungstechnik, vol. 25, 1937, pp. 1–5.

been a very large flush production of each within the State.[94] Piersol[95] has reviewed previous methods of smoke determination and has devised a new method, based on measuring the absorption of a standard beam of light with a Weston photronic cell and a galvanometer. He found a direct proportionality between the smoke index and the percentage of volatile matter in the Illinois and West Virginia coals investigated.

Coal-dust engines.—The high thermal efficiency of the Diesel-type engine has continued to interest German engineers in solving the problems of abrasion by the ash of the coal dust[96] and the introduction of the fuel into the cylinders.[97] Although extremely fine grinding of brown coal is not considered essential by Schor,[98] Pawlikowski[99] proposes to grind especially prepared very low ash coal in a liquid medium until the maximum diameter of the grains of ash-forming material is no greater than the film thickness of the lubricating oil on the cylinder walls. This pulp is then injected into the engine cylinder.

COMPLETE GASIFICATION

The production of carbon monoxide and hydrogen for the synthesis[1] of motor fuels and chemical products has led British and European investigators to study gas-producer and water-gas reactions and equipment with a view to speeding up these processes by increasing gas velocity through the producer,[2] slagging the ash and operating at higher temperatures,[3] enhancing the reactivity of the fuel by adding sodium carbonate,[4] and enriching the air with oxygen[5] with[6] or without increasing the pressure. Experiments in which powdered coke treated with 5 percent sodium carbonate was gasified in a stream of steam-oxygen mixtures led to the conclusion that at 1,000° C. and 5 seconds contact time, practically complete decomposition of steam is obtained.[7] Impregnation of granular coke with 2 percent sodium

[94] Hardy, N. G., Operating Experience with Pulverized Texas Lignite in a Large Central Station: Trans. Am. Soc. Mech. Eng., vol. 58, 1936, pp. 267–275.

[95] Piersol, R. J., II. Smoke Index: A Quantitative Measurement of Smoke: Illinois Geol. Survey. Rept. of Investigations 41, 1936, pp. 31-113; Fuel, vol. 15, 1936, pp. 241-253, 272-283, 316-320, 353-360.

[96] Campbell, C., Research on Pulverized-Coal Engines: Coll. Guard., vol. 152, 1936, pp. 689-690.

[97] Wahl, H., The Conveyance of Powdered Material into Pulverized Fuel Engines: Ztschr. Ver. Deutsch. Ing., vol. 80, 1936, pp. 269-276. Schichau, F., Improvements Relating to the Supply of Pulverulent Fuel to Internal-Combustion Engines: British Patent 452608, Aug. 26, 1936.

[98] Schor, A., The Coal-Dust Motor: Oel, Kohle, Erdoel, Teer, vol. 12, 1936, p. 139.

[99] Pawlikowski, R., Method of Preparing a Pulverulent Fuel and of Operating an Internal-Combustion Engine Therewith: British Patent 453457, Sept. 11, 1936.

[1] Baum, K., Large Water-Gas Generators Especially for the Production of Synthesis Gases: Brenn- u. Treibstoffe 74. VDI-Hauptversammlung Darmstadt 1936, Fachvorträge, VDI-Verlag Berlin NW 7, p. 59. Schultes, W., The Production of Water Gas and Gas for Synthetic Purposes From Bituminous Coal: Glückauf, vol. 72, 1936, pp. 273-285. Chekin, P. A., Semenoff, A. I., and Galinker, I. S., New Processes for Obtaining Hydrogen Starting From Low-Grade Fuel: 15th Cong. Chim. Ind., part 1, Brussels, September 1935, pp. 410C–414C. Laupichler, F. G., Economics of the Water-Gas Shift Reaction: Gas World, vol. 105, 1936, pp. 71. Jäppelt, A., and Steinmann, A., Production of Synthesis Gases at the Experimental Plant of the State Colliery, Freiberg, Saxony: Braunkohle, vol. 35, 1936, pp. 353–357, 372-377.

[2] Grodzovsky, M. K., and Choukhanoff, Z. F., The Primary Reactions of the Combustion of Carbon: Fuel, vol. 15, 1936, pp. 321-328.

[3] Estival, J., Gasification of Low-Grade Fuels From the Point of View of Synthetic Production of Motor Spirit or Methanol: Génie civil, vol. 109, 1936, pp. 405-407.

[4] Dent, F. J., Blackburn, W. H., Williams, N. H., and Millett, H. C., The Investigation of the Use of Oxygen and High Pressure in Complete Gasification. Part I. Gasification With Oxygen: 39th Rept., Joint Research Committee of the Institution of Gas Engineers and Leeds University, Communication 141, 1936, 73 pp.; Gas Jour., vol. 216, 1936, pp. 437-441; Gas World, vol. 105, 1936, pp. 385-387, 421-424.

[5] See footnote 4. Karwat, E., Technical Applications, Present Position, and Future Prospects for the Use of Oxygen: Brennstoff-Chem., vol. 17, 1936, pp. 141-149. Guntermann, W., Industrial-Gas Production From Solid Fuel: Archiv Wärmewirt. vol. 17, no. 3, 1936; abs., Fuel Economist, vol. 12, 1936, pp. 115-118. Gesellschaft für Linde's Eismaschinen A.-G., Process for Obtaining Illuminating Gas, Rich in Hydrogen and Practically Free From Carbon Monoxide From Solid Fuels: British Patent 439832, Dec. 16, 1935.

[6] Millett, H. C., The Lurgi Process for Complete Gasification of Coal With Oxygen Under Pressure: Jour. Inst. Fuel, vol. 10, 1936, pp. 15-21. Coal Carbonization, A New Coal Gas: Vol. 3, 1937, p. 2.

[7] Fleer, A. W., and White, A. H., Catalytic Reactions of Carbon With Steam-Oxygen Mixtures: Ind. and Eng. Chem., vol. 28, 1936, pp. 1301-1309.

carbonate and passing steam and oxygen, preheated to 700°, through it at atmospheric pressure gave a fuel-bed temperature of 1,070° C. and an oxygen consumption of about 35.5 cubic feet per therm of gas produced.[8] Increasing the pressure of the steam-oxygen mixture to 20 or 30 atmospheres increased the methane content of the gas to about 15 percent, thus giving a calorific value to the gas, scrubbed free from carbon dioxide, of about 450 to 500 B. t. u. per cubic foot. A semicommercial plant, using this process (Lurgi) on brown coal, has been furnishing town's gas at Zittau, Germany.[9]

Underground gasification.—Results of the much-publicized Russian experiments on the underground gasification of coal have appeared in English.[10] According to the authors, successful exploitation has proceeded underground at the Gorlovka mine (Donetz Basin), since August 1935, producing gas at the face of the coal by means of periodical blows of air with admixture of oxygen up to 35 percent. A typical composition of the gas obtained, in percent, is given as: Carbon dioxide 18, carbon monoxide 15, hydrogen 20, methane 3, and nitrogen 44; heating value, 150 B. t. u. per cubic foot. Water gas was made by alternately blowing with air and steam or steam and oxygen. Other underground gasification plants are to be established at various mines.[11]

German interest in the encouragement of the use of home-produced automotive fuel is exemplified by several informative reviews [12] of portable gas producers, their efficiencies with various fuels, their use on boats, trucks, and buses, and the problems presented in the purification of the producer gas.

HIGH-TEMPERATURE CARBONIZATION

Continued business improvement is reflected in new oven construction in the United States [13] and abroad.[14] Demand for domestic coke has grown, and a number of papers have been published dealing with improvement of its combustibility [15] by suitable blending of coals, by lowering the coking temperature, and by the addition of sodium

---

[8] See footnote 4.

[9] See footnote 6.

[10] Chekin, P. A., Semenoff, A. I., and Galinker, I. S., Underground Gasification of Coals: Chem. Eng. Cong., 3d World Power Conference, London, June 1936; Paper E12, Fuel Econ., vol. 11, 1936, pp. 331. 335; Coll. Guard., vol. 152, 1936, pp. 1193–1196. The Gas World, The Gasification of Coal Underground: Vol. 105, 1936, p. 47.

[11] Chemistry and Industry, Russia: Vol. 55, 1936, p. 762. Sazonov, N. I., Subterranean Gasification of Coal: Khim. Tverdogo Topliva, vol. 6, 1935, pp. 861–869.

[12] Schultes, W., Solid Fuels in Generator Operation on Street Vehicles: Brennstoff-Chem., vol. 17, 1936, pp. 61–67. Gas und Wasserfach, Gas-Producer Rail Motor-Coach: Vol. 79, 1936, p. 75. Dolch, P., Gasification of Bituminous Coal in the Vehicular Generator: Brennstoff-Chem., vol. 17, 1936, pp. 67–69. Kühne, —, The Use of Home-Produced Solid Fuels in Automotive Conveyances: Technische Mitteilungen Nat. Soz. Bund. Deut. Techniker, Special Number, December 1936, pp. 86–92. Rothman, —, Adaptation of Internal-Combustion Motors to Home-Produced Fuels: Technische Mitteilungen Nat. Soz. Bund. Deut. Techniker, Special Number, December 1936, pp. 92–100. Utilization of Coal Committee, Producer-Gas-Driven Road Vehicles: Institution Min. Eng. (London), Memorandum 20, October 1936, pp. 2–4. Kalpers, H., Gas Production from Tar-Free Fuels for Use in Trucks: Feuerungstechnik, vol. 24, 1936, pp. 159–160.

[13] Wright, C. E., Steel Enters a New Cycle: Iron Age, vol. 139, 1937, pp. 64–81. Knox, J. D., Present Steelmaking Facilities Show Significant Weaknesses If Rush of New Business Continues: Steel, vol. 100, 1937, pp. 109–116.

[14] Boon, W. L., Coke Production and Distribution—Industrial Activity Causes Shortage of Household Supplies: Iron and Coal Trades Rev., vol. 134, 1937, pp. 95–96. Foxwell, G. E., The British Byproduct Coking Industry in 1936: Iron and Coal Trades Rev., vol. 134, 1937, pp. 97–100. Thau, A., Recent Developments in German Coking Practice: Gas World, vol. 106, Mar. 6, 1937, Coking Sec., pp. 34–38.

[15] Cobb, J. W., and Hodsman, H. J., The Relation Between the Properties of Cokes and Their Behavior in the Domestic Grate: Jour. Inst. Fuel, vol. 10, 1937, pp. 127–29. Foxwell, G. E., Some Problems of the Coke-Oven Industry: Gas World, vol. 104, June 6, 1936, Coking Sec., pp. 69–77. Petersen, C. F., The Manufacture and Treatment of Gas Coke: Gas Jour., vol. 213, 1936, pp. 374–376.

carbonate, lime, or other activating agents.[16] Addition of sufficient lime to combine with the coal ash and ½ to 1 percent sodium carbonate to the coal before carbonization is said to activate high-temperature coke sufficiently to ignite readily and burn freely in an open grate, but not as well as low-temperature coke. The cost is about 1.8 to 2.5 shillings per ton of coke. It is believed that no damage will be caused to the oven refractories by the alkalies, but continued practical operation is required to prove this assumption. Experimental oven coking tests indicate that the addition of finely ground durain (splint) or fusain to a highly plastic coking coal increases its hardness and size-stability, whereas the addition of coke dust tends to increase the size of coke but lowers its resistance to abrasion.[17] Bureau of Mines tests showed that the shrinkage of coke in the range between 500° and 900° C. was about the same for a number of different coking coals.[18]

Purification of gas.—The Koppers two-stage thylox process for liquid purification of gas has been installed at the Belle (W. Va.), plant of the du Pont Co.[19] Forty-five million cubic feet of blue water gas per day are purified to a residual sulphur content of 0.2 grain per 100 cubic feet. A Koppers sodium phenolate purification plant, designed to treat 22,000,000 cubic feet of refinery gas per day at 225 pounds per square inch pressure with removal of 95 percent of the hydrogen sulphide, is being built at Philadelphia for the Atlantic Refining Co.[20] Improvements have been made in the operation of the detoxification plant at the Hameln Gas Works. German engineers are not in agreement on the economics of the process.[21] Bunte [22] has developed a new method for study of fouling and revivification of oxide in the dry purification process. It consists in supplying measured volumes of the reactants, hydrogen sulphide and oxygen, to the sample maintained at constant temperature at controlled pressures; the course of the reactions is followed by pressure measurements. The method is adapted to the study of the effect of temperature, moisture content, and alkalinity on the activity and life of the purifying material.

Recovery of benzol and tar.—Sixty pounds of activated carbon and 30,000 pounds of steam per 1,000 gallons of crude light oil recovered

---

[16] Mott, R. A., The Production of Reactive Coke in Coke Ovens: Jour. Inst. Fuel, vol. 10, 1937, pp. 133–135; (summary), Iron and Coal Trades Rev., vol. 133, 1936, p. 892. Fuel, Midland Coke Research Committee, Report of Progress During 1936: Vol. 16, 1937, pp. 49–52. Thomas, H. H., The Production of Domestic Coke in Gasworks: Jour. Inst. Fuel, vol. 10, 1937, pp. 136–137. Roberts, A. A., Smith, C. W., and Hackford, J. E., Improvements in the Distillation of Coal: British Patent 446412, Apr. 27, 1936. Askey, P. J., Domestic Coke by Alkali Activation: Gas Jour., vol. 216, 1936, pp. 677–678. Chemical Age, Domestic Coke by Alkali Activities—Results of Research at Winnington: Vol. 35, 1936, p. 440. Swallow, H. T. S., The Effect of Alkalies on Refractories with Particular Reference to the Gas and Coking Industries: Gas Jour., vol. 216, 1936, pp. 422–424.

[17] Midland Coke Research Committee, Report of Progress During 1936: Fuel, vol. 16, 1937, pp. 49–52. Mott, R. A., and Wheeler, R. V., Coking the Barnsley Seam. Pt. II: Trans. Inst. Min. Eng., vol. 90, pt. 6, 1936, pp. 318–327.

[18] Davis, J. D., and Auvil, H. S., Shrinkage of Low-Temperature Coke on Reheating to a Higher Temperature: Am. Gas Jour., vol. 144, June 1936, p. 11; Proc. Am. Gas Assoc., vol. 18, 1936.

[19] Powell, A. R., The Two-Stage Thylox Process for Complete Removal of Hydrogen Sulphide from Gas: Joint Committee Conference of the Production and Chemical Committee, May 25–27, 1936; Proc. Am. Gas Assoc., vol. 18, 1936; Gas Journal, Two-Stage "Thylox" Process for Hydrogen Sulphide Removal: Vol. 215, 1936, pp. 277–280.

[20] American Gas Journal, Koppers Phenolate Gas-Purification Process: Vol. 146, February 1937, p. 62.

[21] Schuster, F., Rendering Town Gas Nonpoisonous: Gas u. Wasserfach, vol. 79, 1936, pp. 450–454. Dolch, P., The Conversion of Carbon Monoxide with Steam: Gas. u. Wasserfach, vol. 79, 1936, pp. 273–274. Schuster, F., Heat Economy in the Process of Manufacture of Nonpoisonous Gas: Gas u. Wasserfach, vol. 79, 1936, pp. 656–659. Gerdes, H. C., Detoxification of Gas: Gas u. Wasserfach, vol. 79, 1936, pp. 643–645. Muller, W. J., and Graf, E., Removal of Carbon Monoxide from Town Gas: Gas u. Wasserfach, vol. 79, 1936, pp. 302–303. Metzger, R., Removal of Carbon Monoxide from Gas and Its Problems for the Chemical Engineer: Gas u. Wasserfach, vol. 79, 1936, pp. 555–557. Kiesel, H., and Witt, D., Removal of Carbon Monoxide from Manufactured Gas: Gas u. Wasserfach, vol. 79, 1936, pp. 618–620.

[22] Bunte, K., Bruckner, H., and Lenze, A., Investigation of Dry Sulphur Removing Processes: Gas u. Wasserfach, vol. 79, 1936, pp. 669–672, 689–693.

are used at the Beckton Gas Works,[23] probably the largest in the world using active charcoal. Three million gallons of benzol are recovered per annum. Use of activated carbon at other gas works is increasing.[24] The direct recovery of tar, involving the spraying of hot tar into hot oven or retort gases and fractional condensation (Cooke process), has been in successful operation at three [25] plants of the Manchester Corporation for several years. H. Koppers has adapted the pipe still of the petroleum industry to the continuous distillation of tar. Several German plants [26] and one at Beckton, England,[27] are being installed. The gas leaving the condensers is hot and contains a large amount of tar fog; the fog is removed by electric precipitators operating at 85° to 95° C.

LOW-TEMPERATURE CARBONIZATION

Foreign developments.—Low-Temperature Carbonization, Ltd., of Great Britain raised its dividend rate from 3.5 to 6 percent [28] and completed a 288-retort, 500 tons coal per day "coalite" plant at Bolsover colliery.[29] This is the world's largest low-temperature carbonization plant for bituminous coal and the fourth operating on the Parker process. The other three are at Barugh, Doncaster, and East Greenwich (London). The total capacity is about 1,400 tons of coal per day. A process originally developed in America for the distillation of oil shale is being tried by Coal Research Syndicate, Ltd., in a pilot plant capable of carbonizing 70 tons of coal per day, at the Mansfield Colliery.[30] The coal is heated in two vertical, firebrick-lined, steel retorts, by downward passage of hot gases produced by burning part of the enriched gases taken off from the base of the retort. After the distillation zone has reached a point about two-thirds of the way down the charge (12 hours after the retort is charged), the air supply is cut off, and the remainder of the charge is carbonized by maintaining gas circulation. None of the 15 or more processes proposed in recent years for the carbonization of mixtures of coal and oil has attained proved commercial success.[31] Coal & Allied Industries, Ltd., operating the Stephenson-process pilot plant at Seaham Harbor, has failed financially;[32] the National Coke & Oil Co., Ltd., which developed the "Cannock or Mitford process" at Cannock and Tipton,[33] has built a larger plant at Erith [34] said to have a capacity of 1,000

[23] Adam, W. G., and Anderson, G. W., The Recovery of Benzole from Coal Gas: Gas Jour., vol. 215, 1936, pp. 220–223.
[24] Plenz, F., The Designing of Gas Works with Reference to the Recovery of Benzol: Gas Jour. vol. 215, 1936, pp. 384–385.
[25] Coal Carbonization, Direct Recovery of Tar: Vol. 2, 1936, pp. 176–178.
[26] Simon, A., Light-Oil Recovery by the Active Carbon Process at the (Berlin) Charlottesburg Gas Works: Gas u. Wasserfach, vol. 79, 1936, pp. 357–362.
[27] Chemical Age, Coal Processing and Byproduct Treatment. New Methods of Dealing with Tar: Vol. 35, 1936, p. 187.
[28] Gas Journal, Low-Temperature Carbonization, Ltd., Further Improvement Recorded: Vol. 216, 1936, p. 786. Iron and Coal Trades Rev., Low-Temperature Carbonization, Ltd.: Vol. 133, 1936, p. 1118.
[29] Colliery Guardian, Low-Temperature Carbonization. New "Coalite" Plant at Bolsover: Vol. 153, 1936, pp. 764–765. Gas Journal, New "Coalite" Plant for Derbyshire: Vol. 214, 1936, p. 337.
[30] Department of Scientific and Industrial Research, Report of Test on a Retort of the Coal Research Syndicate, Ltd., at Mansfield Colliery: H. M. S. Office, 28 pp. Colliery Guardian, Low-Temperature Carbonization Test on Plant of the Coal Research Syndicate, Ltd., at Mansfield: Vol. 153, July 3, 1936, pp. 1-3. Griggs, A. R., A New Process of Low-Temperature Carbonization: Gas Jour., vol. 213, 1936, pp. 824–825; vol. 214, 1936, pp. 41–42. Coal Carbonization, The C. R. S. Low-Temperature Process: Vol. 2, 1936, pp. 73–75, 80. Fuel Economist, Low-Temperature Carbonization Plant at Mansfield Colliery: Vol. 11, 1936, pp. 426-431.
[31] Brownlie, D., Carbonization of Coal-Oil Mixtures. A Review of Recent Developments: Ind. and Eng. Chem., vol. 28, 1936, pp. 629–635.
[32] Fischer, A., Coal and Allied Industries, Ltd., The Truth at Last—Our Criticism in the Past Justified: Petrol. Times, vol. 36, 1936, pp. 805–808. Webb, R. F., Oil from Coal: London Times, Jan. 15, 1937, p. 8, column 5. London Daily Telegraph, Dec. 29, 1936.
[33] Coal Carbonization, The N. C. O. Coal-Distillation Process: Vol. 2, 1936, pp. 96–103, 111–119.
[34] Fuel Economist, New Oil from Coal Plant at Erith: Vol. 11, 1936, pp. 386–389. Colliery Guardian, Low-Temperature Distillation. The National Coke & Oil Co.'s New Plant at Erith: Vol. 153, 1936, pp. 47–49.

tons of coal per day; Blümner has proposed a process for the production of colloidal fuel whereby equal parts of coal dust and oil are mixed and heated stepwise to 450° C. under a pressure of 25 to 30 atmospheres. Extraction, pressure cracking, low-temperature carbonization, and distillation take place simultaneously, and high yields of light oil and fuel oil are said to be obtained with but little evolution of gas.[35] A national drive for home-produced motor fuels in Germany has created renewed activity in low-temperature carbonization[36] and the recovery of primary tar suitable for hydrogenation. Forty-five coke ovens in the Ruhr are being modified for exhausting gas and tar fog as soon as formed to minimize thermal decomposition.[37] The rotary retorts developed some 15 years ago have disappeared entirely. The present processes for bituminous coal, as described by Thau, use externally heated, intermittently charged retorts. Two Krupp-Lurgi system experimental plants, of 30 to 40 tons coal per day each, have been installed, one at the Amalie mine near Essen and the other in the Saar. These ovens are made of welded-steel plates and consist of alternating rectangular carbonizing cells and heating flues. The cells containing the coal are about 3 inches wide, 6 feet high, and 6 feet long, tapering to a greater width at the bottom. Local overheating of the steel plates is avoided by having an external combustion chamber and circulating the hot combustion gases in the flues between the cells by means of a blower. Carbonizing time is 4 to 6 hours. The BT, the Berg, and the Hinselmann processes, in which coal is carbonized under pressure, are being tried in small pilot plants. Brown coal always has been carbonized at low temperatures. Two new types of carbonizers, the Giessen and the Lurgi, were introduced after the war. In the former, the dried brown coal is carbonized while descending in a thin stream on the outer surface of a vertical, revolving, corrugated cylinder of special alloy-iron, heated on its inner surface. The distillation gases are not diluted by the combustion gases. In the Lurgi carbonizer, the brown coal is heated by direct contact with hot combustion gases circulated through the charge. Consequently, the distillation gases are diluted with combustion gases, and light-oil recovery is reduced. Some 30 Giessen retorts, each of 150 metric tons raw brown-coal capacity per day, and about 40 Lurgi units of 500 to 600 metric tons each per day are installed or under

[35] Thau, A., The Coal-Beneficiation Process of Blümner: Brennstoff-Chem., vol. 17, 1936, pp. 361–366. Brownlie, David, Colloidal Fuel. Description of Different Processes: Ind. and Eng. Chem., vol. 28, 1936, pp. 839–842; The "Blümner" Process. Heat Treatment of Coal-Oil Mixtures under High Pressures: Iron and Coal Trades Rev., vol. 133, 1936, pp. 415–416.

[36] Hansen, J., The Significance of Low-Temperature Carbonization in National Economics: Technische Mitteilungen, Nat. Soz. Bund. Deut. Techniker, Special Number, December 1936, pp. 9–20. Schumacher,—, The Significance of Low-Temperature Carbonization for Gas Works: Technische Mitteilungen, Nat. Soz. Bund. Deut. Techniker, Special Number, December 1936, pp. 20–25. Thau, A., The Technology of Low-Temperature Carbonization: Technische Mitteilungen, Nat. Soz. Bund. Deut. Techniker, Special Number, December 1936, pp. 25–52. Recent Developments of Low-Temperature Carbonization of Solid Fuels in Germany (abs. of paper by F. A. Oetken, given at May 1936 meeting of Verein Deut. Ingenieure): Eng. Prog., vol. 17, October 1936, pp. 229–235. Low-Temperature Carbonization of Bituminous Coal at Gas Works: Gas u. Wasserfach, vol. 79, 1936, pp. 608–612, 885–891, 912–917. The Newer Developments in Coal Carbonization in Germany: Brennstoff-Chem., vol. 18, 1937, pp. 110–113. Low-Temperature Carbonization as a Factor in German Fuel Economics: Oel, Kohle, Erdoel, Teer, vol. 12, 1936, pp. 550–553. Hock, H., The Products of the Low-Temperature Carbonization of Bituminous Coal, Their Properties and Utilization: Technische Mitteilungen, Nat. Soz. Bund. Deut. Techniker, Special Number, December 1936, pp. 52–63. Brownlie, David, Low-Temperature Carbonization and Combustion: Steam Eng., vol. 6, 1937, pp. 279–281. Meyer, F., Results of Low-Temperature Distillation of Bituminous Coal in Modern Plants: Gas u. Wasserfach, vol. 80, 1937, pp. 50–56. Gas Journal, Foreign Developments in Low-Temperature Carbonization: Vol. 217, 1937, pp. 100–101; Fuel Econ., vol. 12, 1936, pp. 57–58. Müller, F., Low-Temperature Carbonization of Bituminous Coal: Oel, Kohle, Erdoel, Teer, vol. 12, 1936, pp. 543–549. Correspondent, Oil from Lignite in Germany: London Times, Jan. 29, 1937, p. 13, column 3.

[37] Winter, H., Relationship Between the Tar Yield and Recovery of Oils and the Low-Temperature Distillation and Carbonization of Bituminous Coal: Glückauf, vol. 72, 1936, pp. 450–454. Thau, A., Recent Development in German Coking Practice: Gas World, vol. 106, Mar. 6, 1937, Coking Sec., pp. 34–38.

construction in Germany at present. The Lurgi process also is suitable for lignite and noncaking bituminous coal, and about 15 units have been erected outside of Germany. In Japan, low-temperature coke has not been able to compete with charcoal as a domestic fuel. It has found some use for blending with coal for the production of metallurgical coke and for making water gas. Four plants have been erected.[38] Success in the medium-temperature carbonization of coal in narrow byproduct-type coke ovens led to the construction, at the New Brancepeth Colliery in England, of an experimental battery of narrow ovens following three different designs—Kemp, Lecocq, and Cellan-Jones—which could be operated at temperatures down to 500° C. With the inside oven walls at 600° C., the coking time was 26 hours, and the coke contained about 9 percent volatile matter.[39] On account of the long coking time and the low oven capacity, the production costs are estimated to be twice that of high-temperature coke.

American developments.—The Lehigh Briquetting Co., at Dickinson, N. Dak., has increased the capacity of its plant for the carbonization of lignite by the Lurgi process to 60,000–70,000 tons of briquets per annum.[40] The plant of the Pittsburgh Coal Carbonization Co., at Champion, Pa., using a modified Wisner process, ran continuously during the year, producing about twice as much smokeless fuel ("Disco") and byproducts as last year.

Tar oils as Diesel-engine fuel.—Experiments with variable-compression Diesel engines by the Low Temperature Coal Distillers Association of Great Britain are said to have led to the solution of the problem of lowering the spontaneous ignition temperature of low-temperature tar without lowering the flash point.[41] Experiments at the Bochum Mining School in Germany with various fuels led to the conclusion that the Diesel motor can be run on coal-tar oil when in hot condition, but that 100-percent coal-tar oil does not give complete combustion when the load fluctuates and therefore is not well-suited for mine locomotives. However, a mixture of refined tar oil with 10 percent paraffin oil functioned satisfactorily and gave 29 percent thermal efficiency and higher mileage per gallon than either gas oil or paraffin oil alone. For positive starting in cold weather an addition of 25 to 30 percent paraffin oil was necessary.[42] It also is possible to use coal-tar fuel for air-cell motors by heating the entering air with a "hot-spot."[43]

[38] Ban, Y., Recent Developments in the Low-Temperature Carbonization Industry in Japan: Chem. Eng. Cong., 3d World Power Conference, London, June 1936, Paper E10. Kawaguchi, M., Low-Temperature Carbonization at the Wanishi Iron Foundry: Jour. Fuel Soc. Japan, vol. 15, 1936, pp. 103-105.

[39] Schwarz, P. A., A Few Notes on Low-Temperature Carbonization: Gas World, vol. 105, 1936, Coking Sec., pp. 139-140: Coal Carbonization, Low-Temperature Carbonization at New Brancepeth: Vol. 3, 1937, pp. 21-25, 30. Colliery Guardian, Low-Temperature Carbonization. Interesting New Ovens (Cellan-Jones, British Patent 451747) Developed by Gibbons Bros., Ltd.: Vol. 154, 1937, pp. 195-198. Low Temperature Carbonization. The Kemp Ovens at New Brancepeth Colliery: Vol 154, 1937, pp. 633-634. Finn, C. P., Smokeless Fuel: Coal Carbonization, vol. 2, 1936, pp. 137-139.

[40] Coal Age, Bituminous Preparation Registers Gains in Capacity and Methods: Vol. 42, 1937, pp. 69-72.

[41] Bristow, W. A., Liquid Fuel from Coal Obtained by Low-Temperature Carbonization: Jour. Inst. Petrol. Technol., vol. 22, 1936, pp 583-594; Fuel Econ., vol. 11, April 1936, p. 266. Foxwell, G. E., Carbonization Products in Relation to British Oil Requirements: Coal Carbonization, vol. 2, 1936, pp. 194-196.

[42] Maercks, J., The Use of Tar from Bituminous Coal and Tar-Oil Mixtures in a High-Speed Diesel Motor: Glückauf, vol. 72, 1936, pp. 697-705. Winter, H., Free, G., and Mönnig, H., Suitability of Phenol-Free Light Oils from Hydrogenated Low-Temperature Tar for Motor Use: Glückauf, vol. 72, 1936, pp. 733-736.

[43] Zinner, Karl, Utilization of Coal-Tar Oils in High-Speed Diesel Engines: Ztschr. Ver. Deut. Ing., vol. 79, 1935, pp. 1319-1326; Rev. combust. liq., vol. 14, 1936, pp. 155-164.

HYDROGENATION AND LIQUEFACTION

The total German capacity for the production of gasoline by the hydrogenation of low-temperature tar, lignite, and bituminous coal was said to be about 800,000 metric tons of gasoline per annum on January 1, 1937.[44] This production consisted of 300,000 tons (350,000 tons annual capacity) from tar and brown coal at the Leuna plant,[45] and 150,000 tons from bituminous coal at the Ludwigshaven plant, both belonging to the I. G. Farbenindustrie; 50,000 tons from bituminous coal by the Hydrierwerke Scholven, A. G., at Gelsenkirchen, Ruhr (ultimate capacity, 125,000 tons);[46] 150,000 to 170,000 tons each from brown-coal tar by two plants operated by Braunkohle-Benzin A. G., Brabag, one at Bohlen, near Leipzig, the other at Magdeburg.[47] An important recent development by the Mathias Stinnes Mühlheimer Bergwerke Verein in the Ruhr is the installation, on an industrial scale, of the Pott and Broche process in which equal parts of coal and 50 percent tetralin plus 50 percent phenols are heated at 375°–400° C. for 3 hours under a pressure of about 70 atmospheres, due to gases formed in the process itself. It is designed for the production of 30,000 to 50,000 tons of Diesel motor fuel per annum.[48] An alternative primary liquefaction process (Uhde) using tar oil as the solvent and coke-oven gas as the source of hydrogen (instead of obtaining hydrogen from the tetralin) is being tested on a pilot-plant scale.[49] Laboratory studies on the extraction of coal by various solvents indicate that depolymerization, followed by colloidal solution, occurs when an appreciable fraction of the coal is dissolved by solvents such as tetralin or coal-tar fractions; and that liquids of medium dipole moment and dielectric constant produce the most marked solvation.[50]

One hundred thousand tons of gasoline were produced from creosote oil, low-temperature tar, and bituminous coal by the hydrogenation plant of Imperial Chemical Industries at Billingham, England, during the first year of operation, ended May 1, 1936.[51] An experimental plant for the hydrogenation of 1 to 2 tons per day of coal tar

[44] German Correspondent: Chem. and Met. Eng., Germany's Motorization Program and Synthetic Motor Fuel and Rubber: Vol. 43, 1936, pp. 618–619. Wright, C. W., Germany's Capacity to Produce Petroleum. Survey of the Substitute Fuel Industry: Petrol. News, Spec. Suppl. 4, vol. 37, January 1937, pp. 46–50; Mineral Trade Notes, vol. 3, no. 5, Nov. 20, 1936, Spec. Suppl. 4, pp. 19–27. For recent reviews of methods and economics of producing motor fuel from coal by the Bergius coal hydrogenation and the Fischer synthetic processes, see: Berthelot, Ch., Carburants de synthèse et de remplacement, Dunod, 92, Rue Bonaparte (VI), Paris, 1936, 350 pp.—Respective Advantages and Disadvantages of the Bergius and Fischer Processes Compared: Chim. et ind., vol. 35, 1936, pp. 768–791. Schlattmann, O., and Koppenberg, H., The Industrial Production of Motor Fuels from Coal in Germany: 3d World Power Conference, Washington, D. C., September 1936, sec. II, Paper 4–A, 20 pp. Motor Fuel Produced from Coal by 3 Processes in Germany: Nat. Petrol. News, vol. 28, Sept. 9, 1936, pp. 24E–34.

[45] Pier, M., The Manufacture of Motor Spirit by the Catalytic Hydrogenation of Lignite Under Pressure: Génie civil, vol. 109, 1936, pp. 7–11.

[46] Zeitschrift des Oesterreiches Vereins von Gas und Wasserfachmännern, Mar. 14, 1936, p. 73; Gas World, Germany's Home Production of Motor Fuels: Vol. 104, 1936, p. 421.

[47] See footnote 46.

[48] Petroleum Times, Diesel Oil from Coal. Is Extraction a Better Avenue than Direct Hydrogenation? Germany's Hopes: Vol. 35, 1936, p. 609; Chem. Trade Jour., vol. 99, 1936, p. 133.

[49] Siegmund, E., Pressure Extraction of Bituminous Coal: Feuerungstechnik, vol. 24, 1936, pp. 158–159.

[50] Agde, G., and Hubertus, R., Investigation of the Colloidal Structure of Bituminous Coals: Braunkohlenarchiv, no. 46, 1936, pp. 3–30. Asbury, R. S., Action of Solvents on Coal. Extraction of a Pittsburgh Seam Coal with Aniline, Tetralin, and Phenol at Elevated Temperatures: Ind. and Eng. Chem., vol. 28, 1936, pp. 687–690. Gillet, A., The Solution of Bituminous Coals in Heavy Oils: Brennstoff-Chem., vol. 17, 1936, pp. 421–429. Wright, C. C., Research in the Hydrogenation of Coal: Black Diamond, vol. 96, Jan. 18, 1936, pp. 22–24.

[51] Smith, F. E., Plant for the Production of Petrol by the Hydrogenation of Bituminous Coal: Engineering, vol. 141, 1936, pp. 648–649, 680–683; Colliery Guardian, The Hydrogenation of Bituminous Coal: Vol. 152, 1936, pp. 1112–1113. Hydrogenation. Vol. 154, 1937, p. 166. Cadman, John, Coal and a Great Experiment: Iron and Coal Trades Rev., vol. 132, 1936, pp. 97–98. Iron and Coal Trades Review, Metallurgical Aspects of Hydrogenation, Design and Manufacture of High-Pressure Forgings: Vol. 132, 1936, pp. 1063–1064. Canadian Chemistry and Metallurgy, Process and Power Steam at Billingham: Vol. 20, 1936, pp. 10–12. Utilization of Coal Committee, Survey of Progress 7: Institution of Mining Engineers, June 30, 1936, p. 2.

has been operated by the British Fuel Research Station.[52] In Japan, a plant for the production of 50,000 tons of gasoline per year is being erected by the Chosen Coal Industry Co.,[53] another with 20,000 tons capacity is being constructed at Fushun by the South Manchurian Railway, a third of 10,000 tons capacity is being planned by the Japanese Electric Co. in North Sakhalin, and a fourth of 25,000 tons capacity by the Mitsui Co. at North Kiushu.[54] In France, plants having a combined capacity of 50,000 tons of gasoline per year have been erected at Bethune and Liévin.[55] The Vallette process[56] used at Bethune is the same in principle as that employed in England and Germany but differs therefrom in that the large reaction chamber is replaced by a number of small-diameter tubes that are easily renewed. Lignites from the Rhone delta are amenable to hydrogenation at a temperature considerably lower than that required for bituminous coal. The Audibert process is used at Lièven.[57] The Canadian[58] and United States[59] Bureaus of Mines are operating small experimental plants for the continuous hydrogenation of about 100 pounds of coal per day, for determining the hydrogenation properties of North American coals.

Research on hydrogenation.—The Fuel Research Station of Great Britain continues to be the principal source of research papers on coal hydrogenation.[60] Continuously operating semitechnical-scale plants, having daily capacities of 1 to 2 tons of coal or tar, are used for studies of the effect of such variables as temperature, pressure, catalyst, time of contact, etc. Phosphorus, nickel, chromium, or silican compounds added to the molybdenum catalyst promote its activity for the reduction of phenol to benzol.[61] Laboratory research in various countries has shown that the composition of the coal,[62] the degree of dispersion, and the nature of the liquid medium greatly affect the hydrogenation process. The best medium for each coal appears to

[52] King, J. G., and Shaw, J. F., The Development of an Intermediate-Scale Plant for High-Pressure Hydrogenation of Tar and Tar Distillates: Chem. Eng. Cong., 3d World Power Conference, London, June 1936, Paper G4. Sinnatt, F. S., King, J. G., and MacFarlane, A., Hydrogenation: Ind. and Eng. Chem., vol. 29, 1937, pp. 133–140.

[53] Chemical Trade Journal, vol. 99, 1936, p. 85. Petroleum Press Service, vol. 3, 1936, pp. 323–324.

[54] Chemistry and Industry, Japan: Vol. 55, 1936, p. 131. Colliery Guardian, Japanese Oil-From-Coal Plans: vol. 152, 1936, p. 918. Journal of the Fuel Society of Japan, vol. 15, 1936, p. 67.

[55] Petroleum Press Service, vol. 3, 1936, pp. 345–347.

[56] Vallette, C., and Audibert, M., The Manufacture of Synthetic Motor Spirit in France from Coal: Génie civil, vol. 108, 1936, pp. 490–492; Chemistry and Industry, France: Vol. 55, 1936, p. 274. Vallette, F., Hydrogenation of Coal: Bull. soc. encour. ind. nat., vol. 135, 1936, pp. 353–365; Nature, Hydrogenation of Coal: A French Process: Vol. 138, 1936, p. 473; Fuel, vol. 15, 1936, p. 269; Gas World, vol. 105, Dec. 5, 1936, Coking Sec., suppl. p. 18.

[57] Audibert, E., Application of Hydrogenation to the Production of Liquid Fuels: Bull. soc. encour., ind. nat., vol. 135, 1936, pp. 366–384; Chemistry and Industry, France: Vol. 55, 1936, p. 274.

[58] Warren, T. E., and Gilmore, R. E., Hydrogenation Tests on Canadian Coal: Ind. and Eng. Chem., vol. 29, 1937, pp. 353–358.

[59] Science News Letter, Washington, D. C., Experimental Plant Making Gasoline from Coal Shown: Vol. 30, Sept. 19, 1936, p. 180.

[60] Winter, H., Free, G., and Mönnig, H., The Hydrogenation of Low-Temperature Tar Under Various Conditions: Oel, Kohle, Erdoel, Teer, vol. 12, 1936, pp. 934–943. Sinnatt, F. S., King, J. G., and MacFarlane, A., Hydrogenation: Ind. and Eng. Chem., vol. 29, 1937, pp. 133–140. King, J. G., and Shaw, J. F., The Development of an Intermediate-Scale Plant for High-Pressure Hydrogenation of Tar and Tar Distillates: Chem. Eng. Cong., 3d World Power Conference, London, June 1936, Paper G4. King, J. G., The Technique of Hydrogenation of Coal and Its Products: Jour. Inst. Fuel, vol. 9, 1936, pp. 323–333; Coll. Guard., vol. 152, 1936, pp. 1106–1108, 1153–1154, 1196–1197. Iron and Coal Trades Review, Hydrogenation of Coal and Its Products. Variables in Process: Vol. 132, 1936, p. 746. Blackie, A., Ockelford, C. W., and Cawley, C. M., Some Thermal and Electrical Aspects of the Design of Converters for the Hydrogenation Process: Proc. Phys. Soc., London, vol. 48, 1936, pp. 339–357.

[61] Kingman, F. E. T., and Rideal, E. K., Effect of Promoters on Molybdenum Catalysts in Hydrogenation: Nature, vol. 137, 1936, p. 529. Griffith, R. H., Promoter Concentration and Catalysis: Nature, vol. 137, 1936, p. 538. Andô, S., High-Pressure Hydrogenation of Low-Temperature Tar. V. Effects of Some Molybdenum Catalysts: Jour. Soc. Chem. Ind., Japan, vol. 39, 1936, pp. 278B–280B.

[62] Rapoport, I., and Khudyakova, A., Hydrogenation of Coal. The Influence of Mineral Content of Coal on the Hydrogenation Process: Khim. Tverdogo Topliva, vol. 7, 1936, pp. 346–359; Chem. Abs., vol. 31, 1937, p. 1583. Lessing, R., Coal as a Source of Liquid Fuel: Jour. Inst. Petrol. Technol., vol. 22, 1936, pp. 577–582. Wright, C. C., and Gauger, A. W., Progress Report on Coal Hydrogenation: Bituminous Coal Research, Inc., Washington, D. C., Tech. Report 2, October 1936, 25 pp.

be its own liquid product.[63] In the partial hydrogenation of young coals, spores and cuticles were unchanged; the hydrogenation products of the coals had a pitchy appearance and softened at temperatures well under the plastic range of the original coals.[64] Russian chemists investigated the effect of various catalysts, temperatures, and pressures on the hydrogenation of primary tars, naphthalene, and tetralin.[65] The best results on peat tar were obtained with molybdenum sulphide at 200 atmospheres pressure and a temperature of 430°–440° C.[66] Gasolines were stabilized and completely freed from sulphur by hydrogenation at 440° C. and 20 atmospheres of hydrogen pressure in the presence of molybdenum sulphide and chromic oxide catalysts.[67] The results of studies [68] of the composition of hydrogenation products of primary tar and oil showing the percentages of olefins, hydroaromatics, aromatics, paraffins, and their boiling ranges, indicate that different final products such as fuel oil, Diesel oil, or gasoline may be produced according to market demands.[69] A general review of the year's literature on hydrogenation leads to the conclusion that tar hydrogenation is advanced much farther commercially than coal hydrogenation, due to mechanical difficulties in dealing with solid materials.[70]

SYNTHETIC PRODUCTS FROM GASES

After 10 years of development work, the Fischer-Tropsch process [71] for the synthetic production of gasoline from carbon monoxide and hydrogen has been placed in commercial operation in Germany. The following plants aggregating a total capacity of 115,000 metric

[63] Rapoport, I. B., and Sudzilovskaya, M. S., Hydrogenation of Coals: Khim. Tverdogo Topliva, vol. 6, 1935, pp. 736–749; Chem. Abs., vol. 31, 1937, p. 1582.

[64] Hovers, T., Koopmans, H., and Pieters, H. A. J., The Partial Hydrogenation of Coal: Fuel, vol. 15, 1936, pp. 233–234.

[65] Shtraler, F. E., Makh, G. M., and Gakhtel, F. G., The Hydrogenation of Tar from Aleksandrisk Brown Coal: Jour. Appl. Chem. (U. S. S. R.), vol. 8, 1935, pp. 1388–1401 (p. 1401 in German). Eru, I. I., Destructive Hydrogenation of Naphthalene and Tetralin. II.: Khim. Tverdogo Topliva, vol. 6, 1935, pp. 831–842; Chem. Abs., vol. 31, 1937, p. 1578. Rapoport, I., and Gritsevich, G., Destructive Hydrogenation of Tars. I. The Influence of the Coarseness of the Catalyst: Khim. Tverdogo Topliva, vol. 6, 1935, pp. 842–851; Chem. Abs., vol. 31, 1937, p. 1587.

[66] Andreevskii, I. L., and others, Destructive Hydrogenation of Peat Tar. I. Hydrogenation in the Liquid Phase: Khim. Tverdogo Topliva, vol. 6, 1935, pp. 926–942; Chem. Abs., vol. 31, 1937, p. 1587. Al'tman, L. S., and others, Motor Fuel from Peat Tar. II. Destructive Hydrogenation in the Vapor Phase: Khim. Tverdogo Topliva, vol. 7, 1936, pp. 31–48; Chem. Abs., vol. 31, 1937, p. 1577. Vainshtein, S. M., and others, Motor Fuel from Peat Tar. III. The Characteristics of the Product of Hydrogenation: Khim. Tverdogo Topliva, vol. 7, 1936, pp. 359–367; Chem. Abs., vol. 31, 1937, p. 1577.

[67] Moldavskii, B. L., and Pokorskii, V. N., Refining Motor Fuels by Hydrogenation. Removal of Sulphur and Stabilization of Gasolines from Primary Tars: Khim. Tverdogo Topliva, vol. 6, 1935, pp. 943–951; Chem. Abs., vol. 31, 1937, p. 1577.

[68] Winter, H., Free, G., and Mönnig, H., Experiments on the Hydrogenation of a Primary Tar from a Westphalian "Flame" Coal: Bergbau, vol. 49, 1936, pp. 147–150. Andô, S., High-Pressure Hydrogenation of Low-Temperature Tar. IV. Hydrogenation of Distillates from Low-Temperature Tar: Jour. Soc. Chem. Ind., Japan, vol. 39, 1936, pp. 133B–134B. Winter, H., and Free, G., Comparative Hydrogenation Experiments: Glückauf, vol. 72, 1936, pp. 256–259.

[69] Pier, M., Coal Hydrogenation. A Comparison of Hydrogentation Products of Coal and Oil: Ind. and Eng. Chem., vol. 29, 1937, pp. 140–145.

[70] Berthelot, C., Hydrogenation of Coal and of Primary Tar: 15th Cong. Chim. Ind., Brussels, September 1935, pp. 817C–822C. Production and Purification of Hydrogen for Hydrogenation of Coal: Génie civil, vol. 109, 1936, pp. 339–340

[71] Schlattmann, O. and Koppenberg, H., The Industrial Production of Motor Fuels from Coal in Germany: 3d World Power Conference, Washington, D. C., September 1936, Sec. II, Paper 4-A, 20 pp. Motor Fuel Produced from Coal by Three Processes in Germany: Nat. Petrol. News, vol. 28, Sept. 9, 1936, pp. 24E–34. Fischer, F., and Pichler, H., Increasing Yields of Fluid Hydrocarbons by Performing the Benzine Synthesis of Franz Fischer and Hans Tropsch in Steps: Brennstoff-Chem., vol. 17, 1936, pp. 24–29. Fischer, F., The Conversion of Coal into Liquid Motor Fuels and Other Products by Way of Carbon Monoxide: Jour. Inst. Fuel, vol. 10, 1936, pp. 10–14; Coll. Guard., vol. 153, 1936, pp. 719–721. Conversion of Coal into Liquid by the Fischer Process: Petrol. Times, vol. 36, 1936, pp. 613–614. Conversion of Coal into Liquid Fuels by the Fischer Process: Chem. Ind., vol. 40, 1937, pp. 33–35. Motor Fuels from Coke: Gas Jour., vol. 216, 1936, pp. 278–279. Hugel, C., Synthetic Petroleum and Its Derivatives: Ann. Off. Comb. Liq., vol. 11, 1936, pp. 719–733. Thau, A., Synthetic Motor Spirit: Coal Carbonization, vol. 2, 1936, pp. 159–163, Muhlert, F., The Production of Motor Fuels and Oils by Synthesis in Germany: Chaleur et ind., vol. 17, 1936, pp. 119–123. "Proteus", Synthetic Petrol by the Fischer Process: Gas World, vol. 105, 1936, pp. 362–363. Myddleton, W. W., and Walker, J., The Production of Hydrocarbon Oils from Industrial Gases, Part II: Chem. and Ind., vol. 55, 1936, pp. 121T–124T. Wright, C. W., Germany's Capacity to Produce Petroleum. Survey of the Substitute Fuel Industry: Petrol. Times, vol. 37, 1937, pp. 46–50.

tons of primary oils per annum are completed or under construction: The Rheinpreussen Colliery at Homberg, 30,000 metric tons primary products, consisting of gasoline, Diesel oil, soft and hard paraffin wax, oils for the production of domestic fats and other chemical uses, from blast furnace coke and coke oven gas;[72] Ruhr Benzin, A. G. (subsidiary of Ruhrchemie), at Oberhausen-Holten,[73] and the Viktor Colliery at Castrop-Rauxel,[74] each 30,000 tons of oil per year from coke; Braunkohle-Benzin, A. G., Brabag, at Ruhland, north of Dresden, 25,000 tons of primary oils from the gasification of brown-coal briquets;[75] Mittel Deutsche Treibstoff und Oel Werke (subsidiary of Wintershall A. G.), at Kassel, 30,000 tons of primary oils from the gasification of brown coal.[76] The Brabag and Ruhland plants were built by the Heinrich Koppers Co. of Essen.[77] Gas containing two parts hydrogen and one part carbon monoxide by volume, suitable for the synthesis of motor fuel, may be produced [78] (*a*) by converting part of the carbon monoxide in water gas with steam in the presence of activated iron oxide at 500° C., to carbon dioxide and hydrogen, and scrubbing out the carbon dioxide with water under pressure;[79] (*b*) by alternately blowing steam-oxygen and steam-coal gas mixtures through an incandescent bed of coke;[80] (*c*) by passing natural gas mixed with steam over a nickel catalyst at 1,000° C.[81] It is reported that the Kuhlmann Co. is erecting a Fischer-process plant in France [82] and that the Mitsui Mining Co. is making a small commercial-scale installation at the Miike Colliery in Japan.[83]

Research on oils and chemical products.—Japanese and other investigators have contributed a number of papers on the action of various catalysts and operating conditions on the Fischer synthesis,[84]

---

72 Indirect hydrogenation: Gas World, Progress in Coal Processing and Byproduct Treatment: Vol. 105, Sept. 5, 1936, Coking Sec., p. 120. Gas Journal, Coal Processing and Byproduct Treatment, Koppers Developments: Vol. 215, 1936, p. 482. Colliery Guardian, Coal Processing and Byproduct Treatment. Development of the Koppers Coke Oven Co.'s Processes: Vol 153, 1936, p. 419. The Situation in Germany. Ruhr Market—1936: Vol. 154, 1937, p. 130. Chemical Age, Coal Processing and Byproduct Treatment. New Methods of Dealing with Tar: Vol. 35, 1936, p. 187.

73 Chemical Age, The Fischer Process: Vol. 35, 1936, p. 367.

74 Utilization of Coal Committee, The Production of Oils from Coke-Oven Gas: Institution of Mining Engineers, Memorandum 19, August 1936, p. 2; Coll. Guard., vol. 153, 1936, pp. 380–381.

75 See footnote 72.

76 Chemical Trade Journal, New German Synthetic Benzine Project: Vol. 99, 1936, p. 50.

77 Colliery Guardian, Coal Processing and Byproduct Treatment Development of the Koppers Coke-Oven Co.'s Processes: Vol. 153, 1936, p. 419.

78 Fuel Economist, Production of Synthesis Gas at Freiberg: Vol. 12, 1936, p. 109. Industrial Gas Production from Solid Fuel: Vol. 12, 1936, pp. 115–118.

79 Schultes, W., The Production of Water Gas and Gas for Synthesis from Bituminous Coal: Glückauf, vol. 72, 1936, pp. 273-285.

80 Studien und Verwertungsgesellschaft m. B. H., Process for Producing Synthetic Gas: British Patent 458022, Dec. 10, 1936.

81 Karzhavin, W. A., Natural Gas. Conversion to Carbon Monoxide and Hydrogen: Ind. and Eng. Chem., vol. 28, 1936, pp. 1042-1044. Chemical Engineering Congress, Production and Utilization of Hydrogen from Gases Containing Methane: 3d World Power Conference, London, June 1936, Paper C17, 17 pp.

82 Chemical Age, Oil from Coal in South Africa. Fischer-Tropsch Plant to be Erected: Vol. 36, 1937, p. 215.

83 Journal of the Fuel Society of Japan, The Production of Gasoline by the Fischer Process: Vol. 15, 1936, p. 89.

84 Simek, B. G., and Kassler, R., Conversion of Carbon Monoxide by Water Vapor on Iron Catalysts: Mitt. Kohlenforschungsinst., Prag., vol. 2, 1935, pp. 125-141. Peters, K., and Winzer, K., Experiments on the Production of Light Spirit from Kogasin II by Cracking: Brennstoff-Chem., vol. 17, 1936, pp. 301-306. Kodama, S., and Fujimura, K., Catalytic Reduction of Carbon Monoxide at Ordinary Pressures. VII. Influence of Alkali Content on the Iron-Copper Catalyst. VIII. Influence of the Proportions of the Two Metals on the Iron-Copper Catalyst: Sci. Papers Inst. Phys. Chem. Res. Tokyo, vol. 29, 1936, pp. 272-279, 280-284. Tsuneoka, S., and Murata, Y., Synthesis of Benzine from Carbon Monoxide and Hydrogen at Ordinary Pressure. XXVII. Ni-Co or Cobalt Alloy Catalysts. XXVIII. Nickel-Alloy Catalysts: Jour. Soc. Chem. Ind., Japan, vol. 39, 1936, pp. 267B-278B; Institute of Physical Chemistry Research, Tokyo, Scientific Papers, vol. 30, 1936, pp. 1-29. Murata, Y., Tsuneoka, S., and Ishikawa, S., Synthesis of Benzine from Carbon Dioxide and Hydrogen at Ordinary Pressure. XXIX. Influence of Tube Width and Length of Layer of Catalyst. XXX. Influence of the Amount of Contact on the Reaction. XXXI. Influence of the Velocity of the Gas Stream on the Reaction: Inst. Phys. Chem. Research, Tokyo, 1936, Science Papers, vol. 30, 1936, pp. 30-39, 40-51, 52-59.

and work has been done on the synthesis of lubricating oils.[85] Methane and higher hydrocarbons can be formed from mixtures of carbon monoxide and hydrogen in the presence of metallic molybdenum, molybdenum sulphide alone, or a molybdenum sulphide-silica gel mixture.[86] A timely and informative volume by Ipatieff,[87] and other important contributions on high-pressure reactions have been published.[88]

New uses for coal.—Interesting new uses for coal proposed during the past year are use of (*a*) anthracite slush as the granular material that is mixed with clay and either common salt or calcium chloride for building so-called "stabilized roads";[89] (*b*) anthracite breaker waste as a light-weight aggregate for concrete;[90] (*c*) production of a base-exchange material for water softening from bone coal by treating it with a sulphonating agent under the action of heat until the granules have expanded but not disintegrated, and removing the excess acid by washing;[91] (*d*) ground coal as filler in road tars,[92] and as a fertilizer ingredient;[93] (*e*) manufacture of brick from fly-ash;[94] (*f*) production of mellitic acid by the chemical oxidation of coal or graphite;[95] and (*g*) production of active carbon for gas masks from durain (splint) coals.[96]

---

[85] Koch, H., Synthetic Lubricants: Ztschr. Ver. Deut. Ing., vol. 80, 1936, pp. 49–51. Some Properties of Synthetic Lubricating Oils from Kogasin: Brennstoff-Chem., vol. 18, 1937, pp. 121–127. Berthelot, C., The Preparation of Lubricants from Coal: Chim. et ind., vol. 36, 1936, pp. 270–280. Chemical Age, Manufacture of Lubricating Oils from Coal. Condensation of Olefines and Chlorinated Hydrocarbons with Aromatic Hydrocarbons: Vol. 35, 1936, p. 139.

[86] Sebastian, J. J. S., The Catalytic Reduction of Carbon Monoxide to Methane at Atmospheric Pressure: Carnegie Inst. Technol. Coal Research Lab. Contrib. 35, 1936, 8 pp.

[87] Ipatieff, V. N., Catalytic Reactions at High Pressures and Temperatures: The Macmillan Co., New York, 1936, 786 pp., $7.50.

[88] Morgan, G. T., Application of High Pressure in the Synthesis of Organic Compounds: Chem. Eng. Cong., 3d World Power Conference, London, June 1936, Paper Gs. Taylor, R., High-Pressure Synthesis of Aliphatic Compounds: Gas World, vol. 104, Apr. 4, 1936, Coking Sec., pp. 38–43. Eguchi, T., The Synthesis of Methanol from Coal: Chem. Eng. Cong., 3d World Power Conference, London, June 1936, Paper G6; Fuel Econ., vol. 11, 1936, pp. 417–420.

[89] Coal Age, Anthracite Industry Presses Drive on Costs and Products: Vol. 42, 1937, pp. 53–56.

[90] See footnote 89.

[91] Furness, R., and Joseph Crossfield & Sons, Ltd., Improvements in or Relating to the Production and Use of Base-Exchange Materials: British Patent 455374, Oct. 14, 1936.

[92] Lougarre, J., Developments in the Use of Coal Filler in Hydrocarbon Binders: Sci. et ind., Special Number la Route, 1936, pp. 103–104.

[93] Peter, C., Soil Conditioner: U. S. Patents 2059599 and 2059600, Nov. 3, 1936.

[94] The Steam Engineer, Pulverized Coal Fly-Ash for Brick Making: Vol. 5, 1936, pp. 280–281, 337–338.

[95] Juettner, B., Mellitic Acid from Coals, Cokes, and Graphites: Jour. Am. Chem. Soc., vol. 59, 1937, pp. 208–213.

[96] Chemistry and Industry, The Production of Absorbent Carbon from Coal: Vol. 55, 1936, pp. 223T–225T. *See also* Fieldner, A. C., Hall, R. E., and Galloway, A. E., A Study of the Production of Activated Carbon from Various Coals and Other Raw Materials: Tech. Paper 479, Bureau of Mines, 1930, 30 pp.

FUEL BRIQUETS

By L. N. Plein and J. B. Clark

SUMMARY OUTLINE

Production of fuel briquets in 1936 amounted to 1,124,973 net tons valued at $7,043,133 f. o. b. plants. Records of production have been kept since 1907, and the output has exceeded that for 1936 only in 1929 when 25 plants produced 1,212,415 net tons valued at $9,515,205. Thirty-two plants, the largest number in the history of the industry, were in operation in 1936. Several of the new plants which started operations in 1936 worked only a few months at the end of the year and therefore produced only a small proportion of their probable annual output.

The volume of packaged fuel produced in 1936 was 66,427 net tons, or more than double the production of 1935, and the number of operating plants increased from 25 in 1935 to 48 in 1936. Because of its special form, such fuel is not included in the statistics of the briquet industry which relate to the production of unwrapped briquets only. Developments in the packaged-fuel industry are discussed separately in this report.

Trends in the industry since 1907 are summarized in the following table:

Salient statistical trends in the fuel-briquet industry in the United States, 1907–36

[The statistics in this and the following tables cover all types of briquets and boulets except the cube-shaped types wrapped in paper and sold under the name "Packaged Fuel." Data regarding the latter are given separately on pp. 966 to 968]

Year or yearly average	Production of briquets: Eastern States (Thousands of net tons)	Production of briquets: Central States (Thousands of net tons)	Production of briquets: Pacific Coast States (Thousands of net tons)	Production of briquets: Total (Thousands of net tons)	Imports (Thousands of net tons)	Consumption[1] (Thousands of net tons)	Value of product, thousands of dollars	Number of plants in operation	Average output per plant, tons	Average value per ton, f. o. b. plant: Pennsylvania	Average value per ton, f. o. b. plant: Central States
YEARLY AVERAGE											
1907-9	(2)	(2)	(2)	99	(3)	99	345	12	8,691	(2)	(2)
1912-15	76	90	53	219	(3)	219	1,037	17	13,179	$2.68	$4.62
1916-20	129	172	107	408	(3)	408	2,763	13	30,640	4.17	7.48
1921-25	188	299	140	627	12	639	5,418	14	43,672	6.04	9.07
1926-30	268	648	115	1,031	84	1,115	8,354	22	47,646	6.42	8.36
1931-35	220	374	59	653	40	693	4,374	27	23,879	5.06	7.18
YEAR											
1929	325	788	99	1,212	89	1,301	9,515	25	48,497	6.22	8.13
1930	301	641	87	1,029	73	1,102	8,029	25	41,155	6.22	8.13
1931	243	382	73	698	61	759	5,261	27	25,864	5.90	8.11
1932	128	296	47	471	80	551	3,459	26	18,100	5.21	7.60
1933	155	318	57	530	42	572	3,498	27	19,646	4.89	6.71
1934	264	388	53	705	-------	705	4,276	27	26,106	4.69	6.54
1935	310	485	66	861	17	878	(4) 5,476	29	29,680	4.60	(4) 7.16
1936	352	701	72	1,125	20	1,145	7,043	32	35,155	(5)	6.95

[1] Production plus imports; the quantity exported has been negligible.
[2] Not available before 1912.
[3] No record of imports is available before 1919, but the quantity imported prior to that time was negligible.
[4] Revised.
[5] Figures cannot be revealed for 1936.

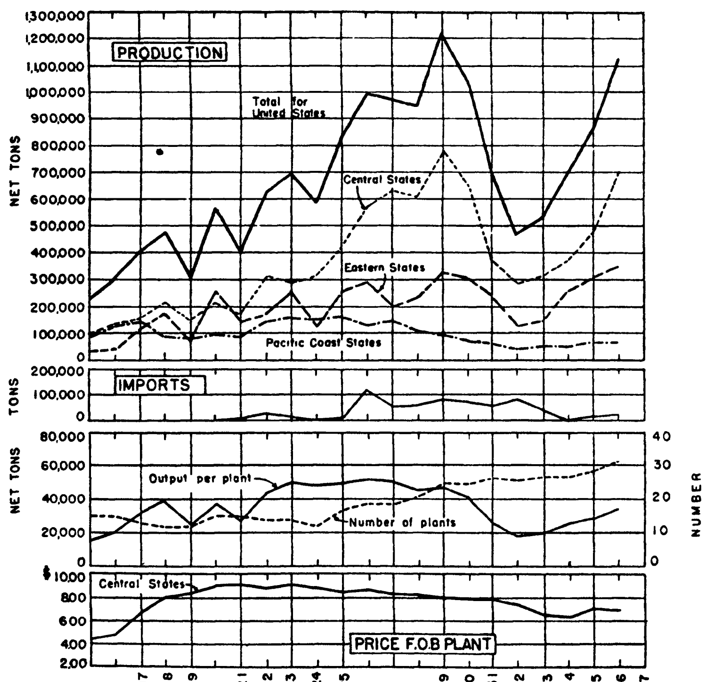


FIGURE 64.—Production and imports of fuel briquets, number of plants in operation, and average price received, f. o. b. plant, 1915–36.

Production.—Production of briquets in 1936 was 1,124,973 net tons, an increase of 264,266 tons or 31 percent over 1935. The three geographical regions shared in this increase, but the greatest gains were made in the Central States (Wisconsin in particular).

Wisconsin is the only State for which production and value can be published without revealing the results of operations of individual companies. The nine plants which operated in Wisconsin in 1936 produced 588,163 tons valued at $4,178,981, which compares with six plants producing 410,715 tons valued at $2,986,847 in 1935. Thus, in 1936 this State alone produced 52 percent of the national output and 59 percent of the total value.

Four plants in West Virginia and Pennsylvania (two in each State) produced 331,478 tons valued at $1,341,218. Other States producing over 20,000 tons and in relative order of importance were Oregon, Missouri, North Dakota, and Massachusetts.

In all, briquets were manufactured in 18 States in 1936 compared with 16 in 1935. The one plant operating in Oklahoma in 1935 was idle in 1936. Three States (Illinois, Indiana, and Michigan) had no production in 1935 but reported a small production in 1936.

Fuel briquets produced in the United States, 1935–36

	1935		1936			
	Net tons	Value	Net tons	Value	Percent of change in— Tonnage	Percent of change in— Value
Eastern States	309,416	$1,386,137	351,502	$1,471,884	+13.6	+6.2
Central States	485,010	[1] 3,474,542	701,544	4,878,200	+44.6	+40.4
Pacific Coast States	66,281	615,449	71,927	693,049	+8.5	+12.6
	860,707	[1] 5,476,128	1,124,973	7,043,133	+30.7	+28.6

[1] Revised.

Monthly production.—The manufacture of briquets is highly seasonal, because they are used chiefly for house heating. Output increases rapidly during the late fall months with a maximum production reached during the winter, followed by a decline during the spring and low output in the summer. Maximum monthly production in 1936 was in February, when 209,765 tons were produced, nearly six times the output of the low month—July. It will be recalled that the winter of 1935–36 was especially severe, particularly the month of February in the Middle West and in the East.

Monthly production of fuel briquets in the United States, 1934–36, in net tons

Month	1934	1935	1936	Month	1934	1935	1936
January	83,607	133,332	146,469	August	38,265	41,674	53,454
February	71,757	85,578	209,765	September	64,420	74,794	78,889
March	55,550	46,165	68,593	October	77,896	112,152	129,829
April	29,104	45,432	40,870	November	83,467	97,393	134,250
May	39,692	47,328	45,421	December	111,836	118,185	127,810
June	22,581	34,334	52,638				
July	26,681	24,340	36,985		704,856	860,707	1,124,973

Value.—The total sales value of the briquets manufactured in 1936 was $7,043,133, f. o. b. plants, a gain of 29 percent over 1935. The gain in total value is due to the 31-percent increase in production. The average value, which was $6.36 in 1935, declined to $6.26 in 1936.

The average for the entire industry is of doubtful significance because of differences in cost of raw material, in freight charges involved in delivery of raw fuel to briquetting plants, and in prices of other fuels with which briquets have to compete.

Average value per net ton of fuel briquets produced in the United States, 1934–36

	1934	1935	1936
Eastern States	$4.72	$4.48	$4.19
Central States	6.54	[1] 7.16	6.95
Pacific Coast States	9.33	9.29	9.64
	6.07	[1] 6.36	6.26

[1] Revised.

The average value for the Eastern States in 1936 was $4.19 compared with $6.95 for the Central States. In the Eastern States nearly all the production comes from plants located chiefly in the low-volatile fields of southern West Virginia and in the anthracite region of Pennsylvania, where the price of raw fuel does not involve freight charges. Hence, the f. o. b. price of briquets at these plants was relatively low. In the Central States 84 percent of the production comes from plants at coal docks on Lakes Michigan and Superior. The raw fuel for such plants involves a considerable freight charge.

Technical developments.—Measured by tonnage or by value of production, fuel briquetting is a small factor in the American fuel industry. Nevertheless, it is interesting to note that research and experimentation are in progress to improve the technology of manufacture and to find new uses for raw coal.

Since 1931, the Illinois State Geological Survey, under the direction of Dr. M. M. Leighton, has been carrying on laboratory research to develop a smokeless briquet that could be made from Illinois coals without the use of a binder.[1] The process developed includes preheating of the raw coal to drive off moisture and some volatile matter; then pressure is applied by impact to form the briquets. Dr. Leighton, in a written communication dated April 13, 1937, states—

The process developed by Dr. Robert J. Piersol * * * for making smokeless briquets without a binder from Illinois bituminous coals is covered by U. S. Patent No. 2021020 and Canadian Patent No. 358755. Doctor Piersol has developed a new-type briquetting press, with patent applied for, for large-capacity commercial production of briquets according to his process. While no smokeless impacted briquets are being manufactured in Illinois at this time, it seems probable that some coal companies will be operating this process on a commercial scale within the coming year. It is estimated that the production cost will be from $0.50 to $1.00 per ton of smokeless briquets.

[1] For details of this research work the reader should consult—
Piersol, R. J., Briquetting Illinois Coals Without a Binder by Compression and by Impact: Rept. of Investigations 31, Illinois State Geol. Survey, 1933, 70 pp. Briquetting Illinois Coals Without a Binder by Impact: Rept. of Investigations 37, Illinois State Geol. Survey, 1935, 75 pp. Smokeless Briquets; Impacted Without Binder from Partially Volatilized Illinois Coals: Rept. of Investigations 41, Illinois State Geol. Survey, 1936, 30 pp.

An interesting 100-page booklet entitled "Fuel Briquetting", by R. A. Strong, E. Swartzman, and E. J. Burrough was published early in 1937 by the Department of Mines and Resources, Ottawa, Canada, and sells for 25 cents (Canadian). Any person interested in the technology or economics of the fuel-briquetting industry will do well to consult this up-to-date report. The principal subjects include history of briquetting, processes, binders, equipment, investigations of briquetting in North America, economics of the industry, and an appendix review of patent literature.

Number and location of plants.—Thirty-two plants reported commercial production of briquets in 1936 compared with 29 in 1935. Six new plants started in 1936, while three plants which operated in 1935 were idle in 1936. The new plants are in the Middle West, as follows: Illinois—Alwart Brothers Coal Co. (Chicago), Indiana—The Gem Coal Co. (Indianapolis), Michigan—Scheele Fuel & Supply Co. (Jackson), and Wisconsin—Pugh Coal Co. (Racine), C. Reiss Coal Co. (Green Bay), and Ubbing Fuel & Dock Co. (Port Washington).

The estimated annual capacity (not to be confused with actual production) of the six new plants is about 120,000 tons, whereas the estimated capacity of the three idle plants was about 45,000 tons. In addition to the six new plants in 1936, notices in the trade journals report new plants starting operations early in 1937 at Chicago (South Chicago Coal & Dock Co.[2]) and at St. Paul (Twin City Briquet Co.[3]). On the other hand, two plants, one of which is in Boston (American Briquet Co.[4]), were to be dismantled early in 1937.

Briquetting plants operated in the United States in 1936

[Does not include makers of paper-wrapped briquets sold under the name "packaged fuel"]

State	Name and address of operator	Location of plant	Date put in operation	Raw fuel used, as reported by producer
Eastern States:				
Massachusetts	American Briquet Co., 1505 Philadelphia Bank Building, Philadelphia, Pa.	Charlestown	1929	Anthracite.
Do.	Staples Coal Co., 80 Federal Street, Boston, Mass.	Fall River	1932	Anthracite and bituminous slack.
Pennsylvania	American Briquet Co., 1505 Philadelphia Bank Building, Philadelphia, Pa.	Lykens	1920	Anthracite.
Do.	Henriette Coal Mining Co., 15 Moore Street, New York, N. Y.	Dunlo	1929	Bituminous low-volatile.
West Virginia	Berwind Fuel Co., 310 South Michigan Avenue, Chicago, Ill.	Berwind	1929	Do.
Do.	Raleigh-Wyoming Mining Co., 230 South Clark Street, Chicago, Ill.	Glen Rogers	1932	Do.
Central States:				
Arkansas	Paris Purity Coal Co., Box 341, Paris, Ark.	Paris	1935	Anthracite.
Do.	Dixie Modern Coal Co., 421 Commerce Building, Pittsburg, Kans.	Ft. Smith	1935	Semianthracite.
Colorado	Acme Smokeless Fuel Co., 212 Davidson Building, Bay City, Mich.	Salida	1931	Anthracite and bituminous slack.
Illinois	Alwart Brothers Coal Co., 1854 Webster Avenue, Chicago, Ill.	Chicago	1936	Bituminous low-volatile.
Indiana	Gem Coal Co., 1125 Roosevelt Street, Indianapolis, Ind.	Indianapolis	1936	Do.
Michigan	Scheele Fuel & Supply Co., 545 North Jackson Street, Jackson, Mich.	Jackson	1936	Do

[2] Coal Heat, January 1937, p. 73.
[3] Black Diamond, Aug. 15, 1936, p. 44.
[4] Saward's Coal Trade Journal, Dec. 19, 1936, p. 776.

Briquetting plants operated in the United States in 1936—Continued

State	Name and address of operator	Location of plant	Date put in operation	Raw fuel used, as reported by producer
Minnesota	Great Lakes Coal & Coke Co., 910 South Michigan Avenue, Chicago, Ill.	St. Paul	1935	Petroleum coke.
Missouri	Binkley Coal Co., 230 North Michigan Avenue, Chicago, Ill.	Kansas City	1909	Anthracite and semianthracite
Nebraska	Christopherson & Renstrom Co., 30th and Boyd Streets, Omaha, Nebr.	Omaha	1932	Petroleum coke.
North Dakota	Lehigh Briquetting Co., Universal Building, Fargo, N. Dak.	Lehigh	1929	Lignite char.
Texas	Magnolia Petroleum Co., P. O. Box 900, Dallas, Tex.	Chaison	1930	Petroleum coke.
Wisconsin	Berwind Fuel Co., 310 South Michigan Avenue, Chicago, Ill.	Superior	1912	Bituminous low-volatile.
Do	C. Reiss Coal Co., Reiss Building, Sheboygan, Wis.	Sheboygan	1933	Do.
Do	do	Green Bay	1936	Do.
Do	Panda Briquet Co., 1019 Foshay Tower, Minneapolis, Minn.	Ashland	1931	Do.
Do	Stott Briquet Co., Inc., 1204 East First National Bank Building, St. Paul, Minn.	Superior	1909	Anthracite and bituminous, low-volatile.
Do	United Coal & Dock Co., 700 West Wisconsin Avenue, Milwaukee, Wis.	Milwaukee	1928	Bituminous, low-volatile and high-temperature coke.
Do	Coal Processing Corporation, 230 South Clark Street, Chicago, Ill.	Superior	1935	Bituminous low-volatile.
Do	Pugh Coal Co., Racine, Wis.	Racine	1936	Do.
Do	Ubbink Fuel & Dock Co., Wisconsin Street and Grand Avenue, Port Washington, Wis.	Port Washington	1936	Do.
Wyoming	Great Lakes Coal & Coke Co., 910 South Michigan Avenue, Chicago, Ill.	Casper	1935	Petroleum coke.
Pacific Coast States:				
California	California Fuel & Utilities Inc., P. O. Box 390, Compton, Calif.	Compton	1931	Do.
Do	Los Angeles Briquet & By-Product Co., 6623 McKinley Avenue, Los Angeles, Calif.	Los Angeles	1933	Do.
Oregon	Portland Gas & Coke Co., Public Service Building, Portland, Oreg.	Portland	1913	Carbon residue from oil gas
Washington	Pacific Coast Coal Co., Foot of Main Street, Seattle, Wash	Renton	1914	Bituminous high-volatile.
Do	Calkins Pressed Fuel Co. of Renton, Renton, Wash.	do	1934	Do.

The success of a briquetting plant depends upon factors such as location, freight rates, accessibility to markets, prices of competing fuels, and cost of raw material. In the following table the production in 1935 and 1936 is grouped according to location of plant with reference to source of supply of raw fuel.

Production of fuel briquets grouped according to location of plants with reference to supply of raw fuel

	Net tons		Change in 1936 compared with 1935	
	1935	1936	Net tons	Percent
Produced at or near Lake Superior or Lake Michigan coal docks	410,715	588,163	+177,448	+43.2
Produced at coal mines	309,015	371,753	+62,738	+20.3
Produced at or near petroleum refineries and oil-gas plants	80,951	83,379	+2,428	+3.0
Other locations [1]	60,026	81,678	+21,652	+36.1
	860,707	1,124,973	+264,266	+30.7

[1] 1935—Boston and Fall River (Mass.), Salida (Colo.), Kansas City (Mo.), St. Paul (Minn.), and Omaha (Nebr.); 1936—Boston and Fall River (Mass.), Salida (Colo.), Kansas City (Mo.), St. Paul (Minn.), Omaha (Nebr.), Chicago (Ill.), Indianapolis (Ind.), and Jackson (Mich.).

Size of plants.—In the following table the plants are classified according to their actual annual output. A more definite indication of size would be a measurement of the annual capacity of each plant, but it is difficult to arrive at an accurate method of determining capacity because of seasonal variations in production. Thus some plants operate three shifts per day for 25 or 26 days per month during the winter and only one shift per day for 10 or 15 days per month during the summer. A modifying factor to be considered in studying the following table is the fact that a new plant with large capacity may start operations in November or December, and its output for these few months may be only a small fraction of its annual output in the succeeding year. A conservative estimate of annual capacities for the six new plants which began operations in 1936 would show that 18 plants instead of 15 could have produced more than 10,000 tons in 1936, and instead of 11 plants producing less than 2,000 tons, there would only be 6.

Classification of briquetting plants by size of output, 1934–36

Output, net tons	Number of plants			Output, net tons	Number of plants		
	1934	1935	1936		1934	1935	1936
Less than 2,000	8	8	11	25,000 and less than 100,000	8	5	4
2,000 and less than 5,000	3	2	1	100,000 and over	1	4	5
5,000 and less than 10,000	3	6	5				
10,000 and less than 25,000	4	4	6		27	29	32

Raw fuels.—A wide variety of raw fuels continues to be used, ranging from North Dakota lignite (after carbonization at low temperature) to Pennsylvania anthracite and including low- and high-temperature coke, oil-gas residue, and petroleum coke.

Classification of briquetting plants, by kinds of raw fuel used in 1936

Kind of raw fuel used:	*Number of plants*
Anthracite or semianthracite fines	5
Mixture of anthracite or semianthracite and bituminous	3
Bituminous:	
Low-volatile	[1] 14
High-volatile	2
Semicoke (low-temperature coke or char)	1
Carbon residue from the manufacture of oil gas	1
Petroleum coke	6
	32

[1] 1 plant using low-volatile coal also reported using breeze of high-temperature coke.

The total quantity of raw fuel briquetted in 1936 was 1,066,570 net tons, of which semibituminous coal was the most important. Fourteen plants used 582,232 tons of low-volatile coal, which represents 55 percent of the total raw-fuel tonnage.

Raw fuels used in making briquets in the United States, 1925, 1929, and 1935–36, in net tons

	Net tons				Percent of total			
	1925	1929	1935	1936	1925	1929	1935	1936
Anthracite and semianthracite culm and fine sizes	383, 189	408, 967	259, 553	296, 806	45. 4	34. 4	31. 5	27. 8
Semibituminous, bituminous and sub-bituminous slack	394, 486	711, 459	449, 570	645, 896	46. 7	59. 9	54. 6	60. 6
Semicoke, coke, oil-gas residue, and petroleum coke	66. 915	67, 513	114, 596	123, 868	7. 9	5. 7	13. 9	11. 6
	844, 590	1, 187, 939	823, 719	1, 066, 570	100. 0	100. 0	100. 0	100. 0

Binders and recarbonization.—Asphaltic pitch is the binder most frequently used in briquet manufacture. Of the 32 plants active in 1936, 19 used asphaltic pitch exclusively. Of the other plants that used binders, two used starch, water, and asphalt; one briquetting asphalt; one coal-tar pitch and asphaltic pitch; two petroleum asphalt; one aspholeum; two starch; one mixed pitches; and one road oil. One plant that briquetted the carbon residue from the manufacture of oil gas required no binder. One other plant reported that briquets were made from low-volatile coal without the use of a binder. The production of this plant was small, and all sales were local.

One producer recarbonized the briquets to drive off the smoke from the binder. Two others reported partly recarbonizing the briquets.

Classification of briquetting plants, by percentage of binder used in 1936

Binder used:	*Number of plants*
Using no binder	[1] 2
Using—	
Less than 5 percent binder	4
5 and less than 7 percent	15
7 and less than 9 percent	10
9 percent and over	1
	32

[1] 1 plant uses carbon residue from the manufacture of oil gas, and 1 plant uses low-volatile bituminous coal as raw fuel.

Weight and shape.—Briquets weighing 2 to 4 ounces dominate the market. In 1936, briquets of this size were made at 19 plants and comprised 89 percent of the total production.

Prevailing weight of briquets manufactured in 1936

Weight of briquet (ounces)	Number of plants making briquets of specified size [1]	Production of briquets	
		Net tons	Percent
Less than 2	5	51, 543	4. 58
2 and under 3	15	802, 047	71. 29
3 and under 4	4	194, 684	17. 31
4 and under 5	3	59, 651	5. 30
5 and under 6	2	6, 395	. 57
6 and under 10	1		
10 and under 16	1		
16 and under 25	4	10, 653	. 95
42 and over	2		
Total	32	1, 124, 973	100. 00

[1] Several plants made briquets of more than 1 size, hence the sum of the items in this column exceeds the total number of briquetting plants.

The type of briquet most frequently reported is pillow-shaped. Of the 32 plants active in 1936, 19 made pillow-shaped briquets, 4 cubes, 3 cylindrical, 2 ovoid or egg-shaped, and 1 trapezoidal. One plant reported making three different shapes—pillow, cylindrical, and ovoid. Another plant made pillow and cylindrical shapes, and still another made oval and rectangular shapes.

Principal expenses and value added by manufacture.—The following table has been prepared from information published by the Bureau of the Census. The Census classification of the fuel-briquet industry includes only those establishments with an output valued at $5,000 or more, in which briquets are the chief products made. The Census, therefore, excludes briquets produced at petroleum refineries or at city gas works, but the returns are representative of independent briquetting plants. The margin between value of product and principal expenses does not represent all profit, as numerous other unreported charges would also have to be deducted.

Analysis of Census of Manufactures data on production of fuel briquets, 1931, 1933, and 1935

Item	1931		1933		1935	
	Total	Per ton	Total	Per ton	Total	Per ton
Number of establishments in the industry	23		24		25	
Production (net tons)	611,179		476,471		794,792	
Principal expenses:						
Salaries	[1] $134,000	[1] $0.22	$106,137	$0.22	[2] $175,000	[2] $0.22
Wages	356,633	.58	261,590	.55	386,131	.49
Materials, power, and fuel used for power at plant	3,034,691	4.97	1,885,567	3.96	3,393,544	4.27
Total	3,525,324	5.77	2,253,294	4.73	3,954,675	4.98
Value of product, f. o. b. plant	4,567,853	7.47	2,943,799	6.18	4,912,578	6.18
Margin between value of product and expenses itemized above [3]	1,042,529	1.70	690,505	1.45	957,903	1.20

[1] Data on salaries paid were not collected in the Census of 1931. The figures used have been estimated from the corresponding returns in 1929 and 1933.
[2] Estimated on basis of 1933 returns at 22 cents per ton.
[3] Not to be confused with profit. Charges for interest, depreciation, taxes, insurance, workmen's compensation, rent, and advertising and all other expenses not itemized above also would have to be deducted.

Distribution.—Briquets are widely used. In 1936 they were produced by 32 plants in 18 States. The product of these plants was shipped to 41 States, District of Columbia, and Alaska and exported to Canada. The largest consumption was in Minnesota, followed by Wisconsin. These two States together consumed 45 percent of the 1936 production.

A large tonnage of bituminous coal moves over the Great Lakes during the summer months and is stored at the head of the Lakes at such ports as Sheboygan, Milwaukee, and Superior, Wis., and Duluth, Minn. During the winter months when the Lakes are closed the coal is reloaded and shipped into the Northwest. The fine coal which results from frequent handling has a lower sales value than the coarse sizes, but a higher-grade product can be made by briquetting, and thus a better realization is obtained. Hence, the largest center of briquet production is in Wisconsin. Briquets apparently find a good market in the cities and towns of Wisconsin and Minnesota.

Fuel briquets of domestic manufacture consumed in the United States and exported to Canada, 1935–36, in net tons

Shipped into—	1935	1936	Shipped into—	1935	1936
Alaska	467	271	Nevada	51	
Arizona	80		New Hampshire	1,979	1,636
Arkansas	38	34	New Jersey	2,777	2,849
California	8,094	6,585	New Mexico	70	21
Colorado	775	441	New York	58,021	57,434
Connecticut	2,240	3,312	North Carolina	5,090	6,935
Delaware	285	504	North Dakota	60,419	72,006
District of Columbia	464	1,234	Ohio	9,459	17,224
Florida	387	585	Oklahoma	92	
Georgia	29	297	Oregon	41,130	46,883
Idaho	402	356	Pennsylvania	24,329	21,003
Illinois	18,831	29,371	Rhode Island	6,165	6,740
Indiana	6,382	10,664	South Carolina	515	743
Iowa	23,068	35,412	South Dakota	43,596	61,906
Kansas	4,841	7,201	Tennessee		91
Kentucky	187	606	Texas	4,350	6,443
Louisiana	782	1,228	Vermont	354	458
Maine	677	770	Virginia	14,753	17,925
Maryland	3,323	4,247	Washington	16,917	16,842
Massachusetts	56,809	47,378	West Virginia	1,730	3,047
Michigan	35,472	54,506	Wisconsin	154,857	213,848
Minnesota	195,384	289,909	Wyoming	3,125	1,086
Missouri	7,564	10,831	Canada	27,049	31,772
Montana	23				
Nebraska	15,214	18,755		858,646	1,111,389

It is not possible to publish a table showing production and destination of shipments for each producing State, because in many States there are only one or two plants and the results of individual operator would be revealed. However, the movement across State lines can be pictured graphically without revealing any confidential information. Figure 65, showing the centers of production and the destination of shipments in 1928 and 1936 indicates the present widespread distribution of fuel briquets.

Foreign trade[5].—Imports of fuel briquets rose to 20,350 net tons in 1936 but were small compared with the domestic production of 1,124,973 tons. The entire tonnage of fuel briquets was imported from Belgium and entered the State of Massachusetts.

Briquets and other composition coals for fuels imported for consumption in the United States, 1932–36

Year	Net tons	Value	Year	Net tons	Value
1932 [1]	80,288	$335,358	1935	16,778	$73,992
1933 [1]	42,395	126,157	1936	20,350	80,210
1934	(2)	(2)			

[1] Beginning July 1, 1932, coal and coke briquets only.
[2] None reported in 1934.

Fuel briquets imported into the United States, 1935–36, by months, in net tons

Month	1935	1936	Month	1935	1936
January	1,511	7,070	August	783	
February	1,457	3,585	September		
March	5,715	3,751	October	3,280	
April			November	1,064	
May			December	2,128	5,944
June	840				
July				16,778	20,350

[5] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

World production.—World production of briquetted fuel is now about 58,000,000 metric tons annually. Germany, France, Belgium, Netherlands, and the United States are the largest producers. The

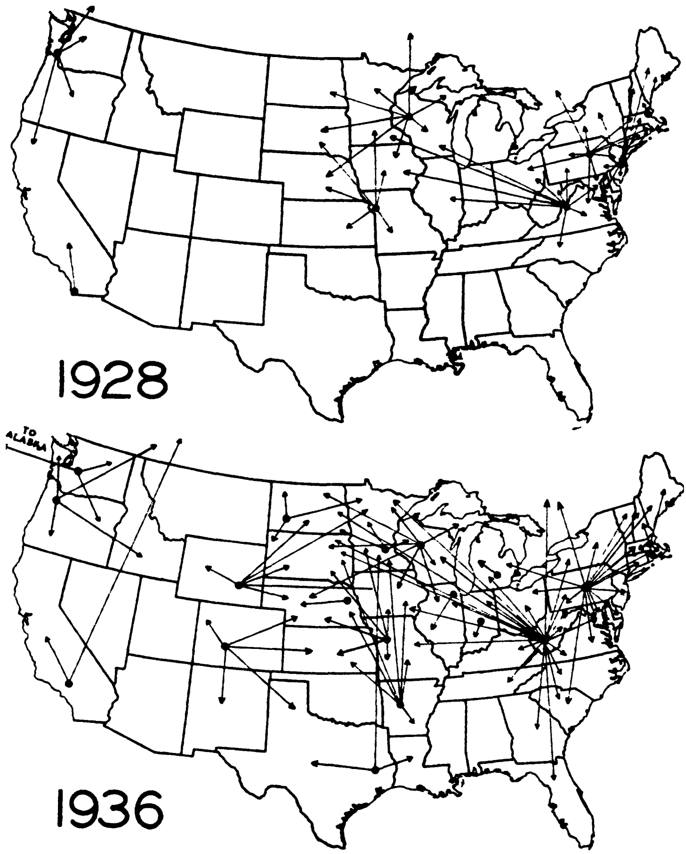


FIGURE 65.—Distribution of fuel briquets in 1928 and 1936. Black dots indicate States in which briquets were produced and arrowheads indicate States into which fuel briquets were shipped from each producing State.

briquetting of lignite in Germany accounts for a large percent of the total world production.

153336—37- -62

World production of fuel briquets, 1932–36, in metric tons

[Compiled by M. T. Latus]

Country [1]	1932	1933	1934	1935	1936
Algeria	71,240	(2)	73,340	48,439	(2)
Australia: Victoria [3]	326,905	312,895	328,807	292,866	366,000
Belgium	1,316,990	1,363,790	1,353,530	1,368,610	1,540,000
Bulgaria	----------	6,234	19,534	43,015	(2)
Czechoslovakia:					
Coal	406,574	396,840	386,463	408,539	414,900
Lignite	202,003	194,497	194,893	188,466	189,300
France	7,538,170	7,533,900	7,946,820	7,999,000	8,110,000
Germany: [4]					
Coal	4,375,512	4,863,940	5,193,279	5,567,508	6,133,000
Lignite	29,752,172	30,064,899	31,384,338	32,837,070	36,082,308
Saar	6,939	7,706	6,105	(4)	(4)
Hungary:					
Coal Lignite	414,421	371,550	328,208	334,766	342,049
Indochina	97,406	73,219	62,231	71,100	(2)
Italy	2,414	4,926	18,290	38,710	(2)
Netherlands:					
Coal	1,170,930	1,102,551	1,087,145	1,087,349	(2)
Lignite	44,025	35,641	33,996	31,352	(2)
Netherland India	6,967	32,948	34,673	46,263	(2)
Poland	222,246	221,911	215,008	192,288	167,407
Portugal	(2)	[5] 727	[5] 511	(2)	(2)
Rumania	43,019	127,274	121,766	239,034	(2)
Spain	785,703	801,953	837,292	814,316	(2)
Tunisia	65,750	56,652	62,941	58,730	(2)
United Kingdom	923,048	955,822	891,303	870,786	(2)
United States	426,923	481,195	639,431	780,816	1,020,553
Venezuela	555	(2)	(2)	(2)	(2)
Yugoslavia	29,851	24,015	23,533	18,365	13,350
	48,229,763	[6] 49,035,085	51,243,437	53,337,388	(2)

[1] In addition to the countries listed briquets are produced in Canada and New Caledonia, but data of output are not available.
[2] Data not available.
[3] Data for year ended Mar. 31 of year stated.
[4] Beginning with March 1935, production of the Saar is included with that of Germany.
[5] From domestic coal only.
[6] Exclusive of Algeria.

PACKAGED FUEL

Sales of packaged fuel began in a small way in 1932, and by 1935, according to reports furnished to the Bureau of Mines, 25,244 net tons were produced at 25 plants. In 1936, 48 plants were in operation and produced 66,427 net tons. The subject of packaged fuel was discussed at some length in the Minerals Yearbook, 1936, pages 658–661.

Packaged fuel is produced at retail yards, usually from the degradation which results from the handling of the coarser sizes. The packages consist of six cube-shaped briquets wrapped in heavy kraft paper and bound with paper tape, usually carrying the advertising of the retail dealer. All packaged fuel is sold locally. The number of packages in a ton varies according to the size and weight of the cubes and ranges from 116 to 200. The latter figure, indicating a weight of 10 pounds per package, is most popular.

The industry is still in its infancy but apparently is very healthy, judging by the 163-percent increase in production in 1936 compared with 1935.

Perhaps the most significant development in 1936 was the sponsorship of packaged fuel by two important producers of low-volatile coal in southern West Virginia. The White Oak Coal Co. in the fall of 1936 contracted for the purchase of 100 Eberling machines "with exclusive package-producing agreements covering all those sections of Illinois, Wisconsin, Michigan, Ohio, and areas in Kentucky imme-

diately south of Cincinnati, which the Eberling firm had not previously assigned to other users."[6] The White Oak Coal Co. will lease but not sell these machines to retail dealers, who must use White Oak Smokeless coal.

One other producer of low-volatile coals was reported to be operating packaged-fuel plants.

While most packaged fuel has been made from yard screenings, it is possible that as the demand increases in any locality, the available supply of yard screenings may not meet production requirements. Part of the profits arises from the fact that the worth of low-value yard screenings can be enhanced by packaging. Several producers have used slack purchased in carload lots at the mines, and the trend in the industry is to turn more and more to slack shipped direct from the mines. This will tend to insure uniform quality, particularly where dealers have used degradation products from several types of coal. Slack prices at the mines tend to increase during times of industrial activity, while the financial success of packaged fuel depends upon obtaining a high quality of coal at a low price. Fortunately, another factor in the coal industry may assist. With the increasing use of domestic mechanical stokers there is an increasing demand for small coal (nut and slack) from which minus ⅜- or minus ¼-inch fines have been removed. The resultant fine coal (minus ⅜-inch) makes an exceptionally good raw fuel for packaging.

Production of packaged fuel.—Packaged fuel was produced in 12 States in 1936, compared with 7 States in 1935. Ninety-two percent of the raw fuel used in 1936 was low-volatile bituminous coal. The following tabulation shows production by geographical areas.

Statistics of paper-wrapped cube-shaped briquets sold as packaged fuel, 1935–36

[The plants and production reported in this table are not included in the preceding tables, which apply to unwrapped briquets only]

	Number of plants		Net tons produced	
	1935	1936	1935	1936
Eastern States [1]	3	5	467	(3)
Central States:				
Ohio	14	17	13,890	21,109
Michigan	5	13	5,283	19,408
Minnesota	1	4	5,604	6,928
Other Central States [2]	2	8		(3)
Pacific Coast States (Washington)		1		(3)
Undistributed				18,982
	25	48	25,244	66,427

[1] 1935—Pennsylvania and Virginia; 1936—Maine, Pennsylvania, and Virginia.
[2] 1935—Indiana and Nebraska; 1936—Indiana, Illinois, Iowa, Nebraska, and Wisconsin.
[3] Production is included under "Undistributed" to avoid disclosure.

The value of packaged fuel, f. o. b. plants was $505,331 in 1936. Average values per ton were $8.60 in Eastern States, $7.31 in Ohio, $8.18 in Michigan, $9.15 in Minnesota, and $6.17 in other Central States (including the one plant in Washington).

The monthly production of packaged fuel is apparently more highly seasonal than the production of fuel briquets; in February, for example, it was nearly 17 times larger than in July. It is not fair to make

[6] Black Diamond, Nov. 7, 1936, p. 18.

comparisons with the last few months of the year when production was running over 10,000 tons because a number of new plants began operating at that time.

Monthly production of packaged fuel in the United States in 1936, in net tons

Month	1936	Month	1936
January	5,281	August	2,180
February	6,267	September	5,203
March	4,643	October	10,416
April	5,644	November	12,394
May	529	December	12,976
June	519		
July	375		66,427

PEAT

By F. M. Shore [1]

SUMMARY OUTLINE

The production of peat in the United States increased substantially in 1936, according to reports received by the Bureau of Mines from the operators of commercial plants that were active during the year. The total production of peat and peat humus amounted to 46,126 short tons that had a selling value of $266,883 at the plant compared with an output of 37,060 tons valued at $199,377 in 1935. In addition to the larger domestic output, imports of peat moss reached the record figure of 75,066 tons, making a total of 121,192 tons of peat available for domestic consumption in 1936 compared with 91,607 in the previous year—an increase of 32 percent.

The larger use of peat by domestic consumers in 1936 apparently bears a direct relation to the general improvement in the economic condition of the country as a whole, including an increased demand for agricultural and horticultural products. It is quite possible, also, that the larger use of peat reflects in some degree a growing appreciation of the beneficial purposes it serves and a wider knowledge of the uses for which it is adapted.

At present the domestic output of peat is chiefly used for soil improvement. Although widely employed as a fuel in various countries of Europe, peat cannot at present compete in the domestic markets with the ample supplies of other higher-grade fuels that are readily available, and no commercial production of peat for use as fuel has been reported in recent years.

Although the present application of domestic peat is relatively small compared with the vast reserves available, it has a wide prospective use as a soil conditioner and is moreover an asset of great potential value for future use, not only as raw material but also in the form of derivative products, such as are now obtained by processing coal.

The record of the progress of the peat industry in this country is outlined in figure 66. The notable increase in the production of peat during the World War period was attributable largely to the shortage and high prices of coal and nitrates; and to the demand for soil improvement to increase the production of food.

The situation in the domestic peat-producing industry in 1936 is indicated by the data herein, which were courteously supplied by producers to cover their operations in that year. Every effort has been made to locate and canvass all commercial operations that

[1] Statistics on quantity and value of peat production compiled by M. Otero of the Bureau of Mines.

produced peat in 1936, and it is believed that the results represent a substantial coverage of the industry. A list showing the names and addresses of operators who reported their production in 1936 to the Bureau of Mines will be furnished upon request to prospective purchasers or others who may be interested.

Reserves.—The United States has extensive reserves of peat, chiefly in the Great Lakes region, in New England, and in the Atlantic and Pacific Coast States. The total peat resources of the country (exclusive of Alaska), calculated on an air-dried basis, were estimated 15 years ago at 13,827,000,000 short tons.[2] The bulk of the reserves is centered in the States of the Upper Lakes region—Minnesota, Wisconsin, and Michigan accounting for approximately three-fourths of the country's total. Of the Atlantic Coast States, Florida, with about 14 percent of the country's total, has the principal peat reserves. California contains most of the known peat reserves of the Pacific Coast region. Approximately one-half of the States of the Union contain substantial peat deposits, although not all are workable. The deposits vary in composition and characteristics and consequently in their value for specific uses, due to differences in the plant material of which they are composed, the conditions surrounding their formation, and the stage of their development. The surface area of the peat lands in the United States has been estimated at more than 100,000,000 acres. The vast extent of the country's peat reserves clearly indicates the importance of this natural resource as a national asset of both present and potential economic value.

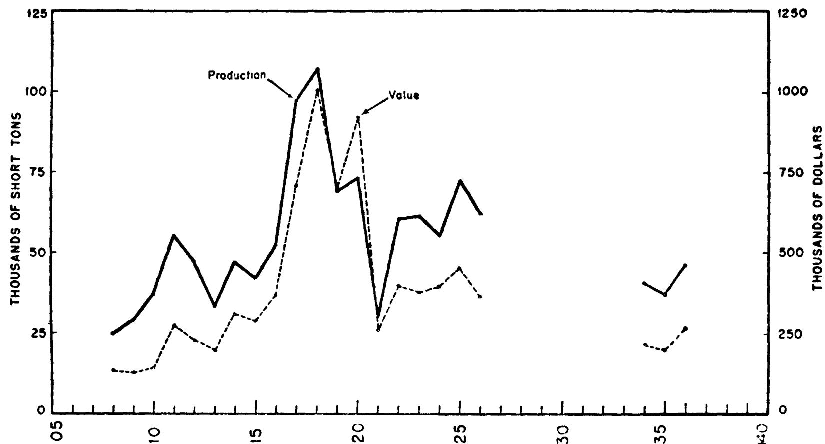


FIGURE 66.—Quantity and value of peat production, 1908-36. No data are available for the period 1927-33.

Production.—The quantity and value of the peat produced in recent years are shown in the following table. The increase of 25 percent in the production for 1936 over that in 1935 is a result of the largest output recorded since the annual canvasses of the industry were resumed by the Federal Government in 1934 after a lapse of 7 years. In addition to the encouraging increase in the output of domestic peat in 1936, the average price per ton realized by producers also made a substantial gain—nearly 8 percent.

[2] Soper, E. K., and Osbon, C. C., The Occurrence and Uses of Peat in the United States: U. S. Geol. Survey Bull. 728, 1922, p. 92.

Peat production in the United States, 1925–36 [1]

Year	Short tons	Value	Year	Short tons	Value
1925	72,436	$452,898	1935	37,060	$199,377
1926	61,936	364,413	1936	46,126	266,883
1934	40,544	214,185			

[1] No canvass 1927–33, inclusive.

The output of peat in 1936 was reported by 40 producers operating in 15 States. The largest outputs were reported by New York and New Jersey, followed by Florida, Michigan, and Ohio in the order named. Other States reporting the production of peat in 1936 were California, Colorado, Indiana, Iowa, Maine, Massachusetts, Minnesota, New Hampshire, Pennsylvania, and Washington. Of the tonnage produced in 1936, about two-thirds was peat humus, most of the remainder consisting of reed or sedge peat. A majority of the operations are equipped with machinery for shredding the peat, although at some deposits it is marketed only in the raw state. Five operations produced cultivated peat. Available data at this time are too meager to serve as a basis for predicting the trend of output in the immediate future. However, since the need for soil improvement is large and the growth in population will require increasing quantities of foodstuffs, it is not improbable that the peat resources of the country will be used more extensively in the future than has been customary in recent years.

Uses.—Most of the peat produced in this country is used for soil improvement, as an ingredient of fertilizers and a soil conditioner. In addition to its use for the improvement of soils for the growing of crops, peat also is used for the improvement of lawns and golf courses and in gardens, nurseries, and greenhouses. It is also used for poultry litter and stable bedding, as packing material for plants, fruits, vegetables, and fragile articles, and for insulation. Of the production in 1936, 72 percent was sold for use in soil improvement. Most of the remainder was sold for use as poultry litter. No sales of peat in 1936 for use as fuel were reported.

Imports.—Imports of peat moss in 1936 were the largest ever recorded and represented an increase of 38 percent in quantity and 41 percent in value over the imports in 1935. Most of the imports of peat moss came from Europe which has ample supplies of this valuable type of peat that can be produced at a relatively low cost. Germany and Sweden together supplied about 92 percent of the total imports. Canada also supplies peat moss to this country; and, although imports from that country are relatively small, they increased materially in both 1935 and 1936.

Peat moss imported for consumption, 1932–36

Year	Short tons	Value	Year	Short tons	Value
1932	64,701	$601,372	1935	54,547	$677,513
1933	41,217	442,766	1936	75,066	955,807
1934	44,132	547,353			

Imports of peat moss, by countries, 1935–36, in short tons

[Compiled from records of the Bureau of Foreign and Domestic Commerce]

Country	1935	1936	Country	1935	1936
Belgium	18		Netherlands	497	984
Canada	1,796	2,657	Norway	1,453	576
Denmark		333	Sweden	18,860	24,283
Estonia	156	343	U. S. S. R.	542	404
Finland	1		United Kingdom	218	336
Germany	30,977	44,951			
Japan	27	42		54,547	75,066
Latvia	2	157			

CRUDE PETROLEUM AND PETROLEUM PRODUCTS[1]

By A. G. White, G. R. Hopkins, and H. A. Breakey

SUMMARY OUTLINE

The outstanding feature of the petroleum industry in 1936 was the increase of about 111 million barrels (approximately 10 percent) in the total demand for all oils. Moreover, the volume of both production and consumption exceeded all previous records. The trend of demand has been steadily upward since 1932, and statistics available for the first quarter of 1937 indicate further substantial gains. Each annual addition to the enormous total volume of crude oil required emphasizes the difficulty of developing substitute sources and the desirability of conserving our known supplies.

The following table shows the trend of the demand for all oils since 1929.

Total demand for all oils, 1929–36

[Millions of barrels of 42 gallons]

Year	Domestic demand	Exports	Total demand	Year	Domestic demand	Exports	Total demand
1929	940.1	163.1	1,103.2	1933	868.5	106.7	975.2
1930	926.4	156.5	1,082.9	1934	920.2	114.5	1,034.7
1931	903.2	124.4	1,027.6	1935	983.7	129.0	1,112.7
1932	835.5	103.3	938.8	1936	1,093.2	130.0	1,223.2

The proved oil reserves of the United States were estimated at 13,632 million barrels as of January 1, 1935, in a report prepared by the Committee on Petroleum Reserves of the American Petroleum Institute. A preliminary estimate for January 1, 1937, by the same committee indicated a reserve of 13,063 million barrels. This latter estimate may be subject to later revision upward. Apparently, during the past 2 years additions to proved reserves may have balanced production. To supply current market demands requires an active

[1] Figures for 1936 are preliminary; detailed data with final revisions will be released later.

campaign of drilling and prospecting. New oil and gas wells completed in 1936 totaled 25,166, and the estimated number of producing wells at the end of the year was about 350,000.

Increasing demand and active control of new production in the major producing States resulted in a reasonable balance between supply and demand. The total stocks of all oils were reduced by about 23 million barrels. In considering the significance of this reduction, it should be noted that motor-fuel stocks increased by about 6 million barrels; but, despite this increase, the supply of motor fuel at the end of 1936, measured by the average daily demand for the year, was equivalent to about 46 days' requirements, the same as at the end of 1935. Furthermore, a considerable part of the decline in crude stocks was due to the liquidation of older storage as a result of a favorable market for fuel oils.

The domestic production of crude petroleum approximated 1,099 million barrels in 1936, an increase of 102 million barrels over 1935 and 92 million barrels over the previous peak in 1929. Texas, California, and Oklahoma were the three leading producers in 1936. The combined production of these States represented 77 percent of the total output in 1936, compared with 79 percent in 1935 and 84 percent in 1929. The largest increases in production compared with 1935 were 59 percent for Louisiana and 33 percent for New Mexico. The six member States of the Interstate Oil Compact contributed 66 percent of the total production in 1936.

Crude-oil runs to stills in 1936 totaled 1,068 million barrels and exceeded all previous records, showing an increase of 102 million barrels over 1935 and 80 million barrels above the previous record established in 1929. An increase in the amount of crude refined in the Texas Gulf district from 153 million barrels in 1929 to 233 million in 1936 and an increase in the Illinois-Indiana district from 110 million barrels in 1929 to 148 million in 1936 are the most significant shifts in the location of the refining industry during recent years.

New records were established for both production and consumption of motor fuel. Domestic demand reached 482 million barrels in 1936, or almost 11 percent more than in 1935. The most significant factor was the increase in number of motor vehicles in use; others contributing were the revival of tourist traffic and favorable weather conditions in the latter part of the year. The yield of gasoline from crude declined from 44.2 percent in 1935 to 44.1 percent in 1936 and may be attributed to the increase in demand for heating oils and distillates and to increased losses due to re-forming. The yield of cracked gasoline (22.4 percent) exceeded that of straight-run gasoline (21.7 percent) for the first time. Stocks of motor fuel were about 6 million barrels higher at the end of the year than at the end of 1935, but days' supply on the basis of average daily demand for the year remained almost unchanged. It should be noted, in connection with the seasonal changes in the stocks of gasoline, that the increasing demand for distillates apparently is tending to cause an earlier and larger accumulation of stocks, which must be reduced more sharply in later months of peak demand.

The total domestic demand for fuel oils—gas oils, distillates, and crude used for fuel—was 409 million barrels in 1936, an increase of 12 percent compared with 1935. The refinery production of the lighter oils gained over 25 percent and the output of residual fuel oil about 10 percent. The future production of residual fuel oils will be

influenced by the increase in cracking, the expanding market for lighter distillates, and any increases in the price of crude oil.

The production of kerosene in 1936 amounted to 56 million barrels. Exports totaled almost 7 million barrels, and domestic demand was over 51 million. Production of kerosene attained its peak in 1926, when the total was about 62 million barrels, but the decline in exports has prevented duplication of this record. Domestic demand in 1936, however, was the highest ever recorded. The growth in the demand for range oils and for kerosene to be used as tractor fuel are important factors contributing to the increased use of kerosene.

The domestic demand for lubricants rose from 20 million barrels in 1935 to almost 23 million in 1936, but exports of lubricants changed little. Domestic consumption was about 1 million barrels below the record for 1929.

World production of crude petroleum increased by about 136 million barrels in 1936 and totaled 1,790 million barrels. The United States supplied about 102 million barrels of this advance, with Russia and Venezuela increasing by 8 and 7 million barrels, respectively. Imports of crude into the United States rose slightly in 1936, but exports decreased by more than 1 million barrels. Imports of refined products increased by about 4 million barrels for the year and exports by about 2 million.

The trend of the supply and demand of all oils, 1918–36, is shown graphically in figure 67.

Salient statistics of crude petroleum, refined products, and natural gasoline, 1932–36

	1932	1933	1934	1935	1936 [1]
Crude petroleum:					
Domestic production......thousands of barrels [2]..	785, 159	905, 656	908, 065	996, 596	1, 098, 516
World production........do....	1, 310, 298	1, 441, 007	1, 522, 816	1, 654, 593	1, 790, 271
United States proportion of world production percent..	60	63	60	60	61
Imports [3]......thousands of barrels [2]..	44, 682	31, 893	35, 558	32, 239	32, 327
Exports [3]........do....	27, 393	36, 584	41, 127	51, 430	50, 184
Stocks, end of period [4]........do....	339, 715 [5] 339, 875	355, 312 [5] 354, 223	337, 254	314, 855	288, 184
Runs to stills........do....	819, 997	861, 254	895, 636	965, 790	1, 068, 134
Total value of domestic production at wells thousands of dollars..	680, 460	608, 000	904, 825	961, 440	1, 150, 000
Average price per barrel at wells........	$0. 87	$0. 67	$1 00	$0. 97	$1. 05
Total producing oil wells in the United States, Dec. 31........	321, 500	326, 850	333, 070	340, 990	(6)
Total oil wells completed in the United States during year........	10, 444	8, 068	12, 512	15, 108	17, 800
Refined products:					
Imports [3]......thousands of barrels [2]..	29, 812	13, 501	14, 936	20, 396	24, 491
Exports [3]........do....	75, 882	70, 143	73, 380	77, 557	79, 832
Stocks, end of period [4]........do....	247, 188 [5] 249, 116	244, 578 [5] 244, 295	223, 356 [5] 222, 682	223, 361	226, 194
Output of motor fuel........do....	399, 712	407, 932	423, 801	468, 021	515, 485
Yield of gasoline........percent..	44. 7	43. 7	43. 4	44. 2	44. 1
Completed refineries, end of year........	505	591	631	632	(6)
Daily crude-oil capacity of refineries thousands of barrels [2]..	3, 890	3, 918	4, 059	4, 117	(6)
Average tank-wagon price (excluding tax) of gasoline in 50 United States cities cents per gallon [7]..	12 45	11. 62	12. 26	12. 02	12. 62
Natural gasoline:					
Production......thousands of barrels [2]..	36, 281	33, 810	36, 556	39, 333	42, 041
Stocks, end of period........do....	3, 203	3, 317 [5] 3, 680	3, 740 [5] 4, 216	3, 698	4, 055

[1] Preliminary.
[2] 42 gallons.
[3] From Bureau of Foreign and Domestic Commerce. Imports of crude petroleum in 1934 as reported to the Bureau of Mines; exports include shipments to Alaska, Hawaii, and Puerto Rico.
[4] California heavy crude and fuel oil included under refined products.
[5] For comparison with succeeding year.
[6] Not available.
[7] From American Petroleum Institute.

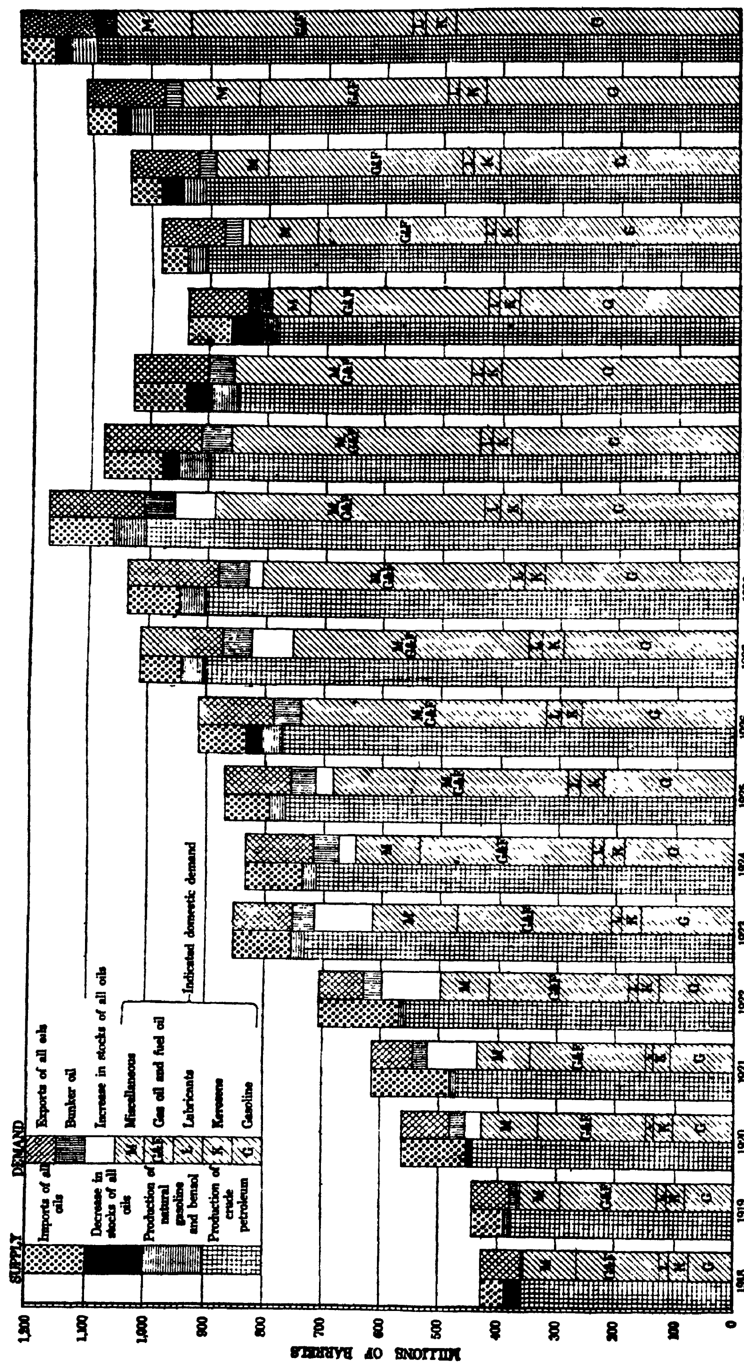


FIGURE 67.—Supply and demand of all oils, 1918–36.

Salient statistics on the supply and demand of all oils, 1935–36

[Thousands of barrels of 42 gallons]

	1935		1936 [1]	
	Total	Daily average	Total	Daily average
New supply:				
Domestic production:				
Crude petroleum	996,596	2,730	1,098,516	3,001
Natural gasoline	39,333	108	42,041	115
Benzol	1,871	5	2,537	7
Total production	1,037,800	2,843	1,143,094	3,123
Imports: [2]				
Crude petroleum	32,239		32,327	
Refined products	20,396		24,491	
Total new supply, all oils	1,090,435	2,987	1,199,912	3,278
Change in stocks, all oils	−22,238	−61	−23,267	−64
Demand:				
Total demand, all oils	1,112,673	3,048		3,342
Exports:				
Crude petroleum	51,430	141	50,184	137
Refined products	77,557	212	79,832	218
Domestic demand:				
Motor fuel	434,810	1,191	481,591	1,316
Kerosene	47,645	131	51,479	141
Gas oil and distillate fuel oil	86,028	236	103,462	282
Residual fuel oil	280,695	769	305,529	835
Lubricants	19,661	54	22,676	62
Wax	933	3	1,076	3
Coke	6,703	18	6,267	17
Asphalt	15,652	43	22,185	61
Road oil	5,962	16	7,689	21
Still gas (production)	51,184	140	54,441	149
Miscellaneous	1,973	5	2,223	6
Losses and crude used as fuel	32,440	89	34,545	94
Total domestic demand	983,686	2,695	1,093,163	2,987
Stocks (end of year):				
Crude petroleum	314,855 [3] 314,631		288,184	
Natural gasoline	3,698		4,055	
Refined products	223,361 [3] 223,371		226,194	
Total, all oils	541,914 [3] 541,700		518,433	
Day's supply	178		155	

[1] Preliminary.
[2] Imports of crude as reported to Bureau of Mines; all other imports and exports from Bureau of Foreign and Domestic Commerce.
[3] For comparison with 1936.

Supply and demand of all oils in 1936, by months [1]

[Including wax, coke, and asphalt in thousands of barrels of 42 gallons]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1936	1935
New supply:														
Domestic production:														
Crude petroleum	88,820	82,120	90,568	90,479	93,739	90,185	92,078	95,090	90,972	95,795	91,018	97,652	1,098,516	996,596
Daily average	2,865	2,832	2,922	3,016	3,024	3,006	2,970	3,067	3,032	3,090	3,034	3,150	3,001	2,730
Natural gasoline	3,653	3,196	3,378	3,265	3,275	3,217	3,355	3,507	3,584	3,830	3,816	3,965	42,041	39,333
Benzol	186	174	185	204	221	218	210	219	216	230	228	246	2,537	1,871
Total production	92,659	85,490	94,131	93,948	97,235	93,620	95,643	98,816	94,772	99,855	95,062	101,863	1,143,094	1,037,800
Daily average	2,989	2,948	3,036	3,132	3,137	3,121	3,085	3,188	3,159	3,221	3,169	3,286	3,123	2,843
Imports: [2]														
Crude petroleum	1,875	2,626	2,446	2,857	3,049	2,649	2,647	3,009	2,844	2,955	2,756	2,614	32,327	32,239
Refined products	1,688	1,545	1,960	2,013	2,196	2,304	2,074	1,909	2,359	2,372	1,965	2,106	24,491	20,396
Total new supply, all oils	96,222	89,661	98,537	98,818	102,480	98,573	100,364	103,734	99,975	105,182	99,783	106,583	1,199,912	1,090,435
Daily average	3,104	3,092	3,179	3,294	3,306	3,286	3,238	3,346	3,333	3,393	3,326	3,438	3,278	2,987
Change in stocks, all oils	−224	+1,768	+5,561	+2,314	+3,304	−4,127	−4,798	−3,332	−9,686	−5,049	−5,158	−3,840	−23,267	−22,238
Demand:														
Total demand	96,446	87,893	92,976	96,504	99,176	102,700	105,162	107,066	109,661	110,231	104,941	110,423	1,223,179	1,112,673
Daily average	3,111	3,031	2,999	3,217	3,199	3,423	3,392	3,454	3,655	3,556	3,498	3,562	3,342	3,048
Exports: [2]														
Crude petroleum	3,067	3,474	3,155	3,743	4,390	4,792	4,458	5,561	5,025	4,708	4,145	3,666	50,184	51,430
Refined products	7,095	5,378	5,777	6,282	7,836	6,606	6,297	6,811	6,785	6,518	7,941	6,506	79,832	77,557
Domestic demand:														
Motor fuel	32,412	27,216	35,871	38,825	42,007	44,630	46,638	46,081	44,346	44,253	39,919	39,393	481,591	434,810
Kerosene	5,569	4,785	4,098	3,914	4,035	3,075	3,019	3,218	4,305	4,370	4,943	6,148	51,479	47,645
Gas oil and distillate fuels	11,764	11,881	8,414	6,842	4,858	5,145	6,139	6,178	8,238	8,712	11,131	14,160	103,462	86,028
Residual fuel oils	26,918	26,251	25,782	24,702	24,114	24,330	23,520	23,474	25,913	27,301	24,892	28,332	305,529	280,695
Lubricants	1,396	1,520	1,863	2,197	2,028	1,969	2,123	1,851	2,059	1,911	1,938	1,821	22,676	19,661
Wax	89	85	84	92	91	114	82	82	80	96	79	102	1,076	933
Coke	699	644	349	483	466	543	476	409	529	601	512	556	6,267	6,703
Asphalt	697	878	989	1,666	1,883	2,118	2,564	3,142	2,974	2,504	1,689	1,081	22,185	15,652
Road oil	141	100	260	241	593	1,219	1,488	1,351	1,108	631	308	249	7,689	5,962
Still gas (production)	4,102	3,833	4,136	4,366	4,818	4,831	4,951	4,947	4,743	4,680	4,437	4,597	54,441	51,184
Miscellaneous	169	179	195	203	193	206	151	193	215	193	161	165	2,223	1,973
Losses and crude as fuel	2,328	1,669	2,003	2,948	1,864	3,122	3,256	3,768	3,341	3,753	2,846	3,647	34,545	32,440
Total domestic demand	86,284	79,041	84,044	86,479	86,950	91,302	94,407	94,694	97,851	99,005	92,855	100,251	1,093,163	983,686
Daily average	2,783	2,726	2,711	2,883	2,805	3,043	3,045	3,055	3,262	3,194	3,095	3,234	2,987	2,695

Stocks:														
Crude petroleum	313,081	310,812	313,189	315,389	315,169	311,046	306,390	301,757	295,693	292,271	288,998	288,184	288,184	314,855
Natural gasoline	3,936	4,218	4,553	5,058	5,664	5,829	5,846	5,653	4,945	4,555	4,153	4,055	4,055	3,698
Refined products	224,459	228,214	231,063	230,672	233,590	233,421	233,262	234,756	231,842	230,605	229,122	226,194	226,194	223,361
Total stocks, all oils	541,476	543,244	548,805	551,119	554,423	550,296	545,498	542,166	532,480	527,431	522,273	518,433	518,433	541,914

[1] Preliminary.
[2] Imports of crude as reported to Bureau of Mines; all other imports and exports from Bureau of Foreign and Domestic Commerce.

LEGISLATION AND TAXES

Compared with the 3 previous years 1936 was a period of comparative quiet as far as legislation and regulation of production were concerned. No important oil bills were passed by the Federal Government, and, with the possible exception of Louisiana, no State changed its laws on oil conservation materially. By far the major portion of the task of balancing supply and demand of crude petroleum in 1936 was performed by the various State regulatory bodies, with the participation of the Federal Government mainly confined to cooperation through the Interstate Compact, to enforcement of the Connally law curbing "hot oil" production, and to the continuation of the monthly forecast reports of the Bureau of Mines.

No basic change in organization and functions of the Interstate Compact was effected in 1936. Although overtures were made to some States to join the Compact in 1936, there was no change in the roll of the compacting States, which remained as follows: Texas, Oklahoma, Kansas, New Mexico, Illinois, and Colorado. Perhaps the outstanding instance of cooperation between the Interstate Compact and the Federal Government in 1936 was in connection with the survey to determine the quantities and characteristics of crude-oil stocks.

The Connally bill, banning the movement of illegally produced crude in interstate and foreign commerce, was signed by the President on February 22, 1935, and was to be effective through June 15, 1937. In 1936 most of the Federal activities were centered in the Federal Tender Board, Kilgore, Tex., whose operations were supervised by the Petroleum Conservation Division, Department of the Interior; this Division succeeded the Petroleum Administrative Board on April 1, 1936.

The monthly forecast reports of the Bureau of Mines, which, beginning July 1935, followed the allocation reports of the Federal Agency under the Petroleum Code, were issued throughout 1936 as economic guides for the State regulatory bodies and for the industry. As shown in the following table, actual production generally exceeded the Bureau's estimates; in the main this was because the industry did not reduce gasoline stocks as much as anticipated and because the increase in demand exceeded expectations.

At the close of 1936 the Federal import taxes on crude petroleum and petroleum products were as follows: Gasoline, 2½ cents per gallon; lubricating oils, 4 cents per gallon; crude oil and fuel oil, ½ cent per gallon; and wax, 1 cent per pound. Manufacturers' excise taxes were: Gasoline, 1 cent per gallon, and lubricating oil, 4 cents per gallon. The production and processing tax on crude petroleum was reduced from one-tenth to one twenty-fifth of a cent per barrel. The 4-percent tax on pipe-line transportation charges remained in effect. Except for the reduction in the production and processing tax, no changes were made in these taxes in 1936.

State allowables and Bureau of Mines estimates of required production,[1] compared with actual production, 1935–36

[Daily averages, in thousands of barrels of 42 gallons]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1935												
Texas:												
State allowable [2]	1,029	1,048	1,053	1,046	1,064	1,083	1,065	1,038	1,045	1,044	1,085	1,093
Bureau of Mines estimate	1,007	1,032	1,020	1,021	1,033	1,059	1,064	1,062	1,060	1,026	1,028	1,006
Actual production	1,031	1,077	1,082	1,056	1,067	1,090	1,074	1,060	1,069	1,064	1,094	1,094
Oklahoma:												
State allowable [3]	489	497	491	493	500	514	517	491	491	493	492	480
Bureau of Mines estimate	489	497	491	493	500	514	517	516	506	493	492	480
Actual production	491	490	505	522	523	518	530	495	498	515	511	496
California:												
State allowable [4]	474	489	493	493	494	526	510	543	530	591	591	591
Bureau of Mines estimate	474	489	493	493	494	513	513	512	500	498	505	514
Actual production	500	499	498	473	495	557	562	600	640	650	677	678
Kansas:												
State allowable [5]	142	154	143	141	148	154	156	140	141	146	143	139
Bureau of Mines estimate	137	139	140	141	148	154	156	155	152	146	143	139
Actual production	137	149	156	152	153	154	157	149	152	154	146	144
Louisiana:												
State allowable [6]	108	114	115	116	120	132	140	139	143	143	149	157
Bureau of Mines estimate	100	110	111	111	112	132	130	130	126	125	127	128
Actual production	111	114	116	127	134	137	139	141	146	153	157	163
New Mexico:												
State allowable [7]	52	50	53	53	55	57	59	60	60	60	61	62
Bureau of Mines estimate	50	49	49	50	52	55	54	54	51	51	52	56
Actual production	54	50	54	55	54	56	58	59	59	59	60	60
Other States:												
Bureau of Mines estimate	203	210	216	218	222	224	226	226	218	215	217	217
Actual production	215	220	218	229	234	233	238	232	240	249	238	227
United States:												
Bureau of Mines estimate	2,460	2,526	2,520	2,527	2,561	2,651	2,660	2,655	2,613	2,554	2,564	2,540
Actual production	2,539	2,599	2,629	2,614	2,660	2,745	2,758	2,736	2,804	2,844	2,883	2,862
1936												
Texas:												
State allowable [2]	1,060	1,106	1,147	1,191	1,188	1,172	1,172	1,193	1,171	1,219	1,170	1,246
Bureau of Mines estimate	1,017	1,068	1,104	1,123	1,133	1,126	1,147	1,155	1,124	1,107	1,109	1,145
Actual production	1,066	1,124	1,144	1,188	1,188	1,179	1,159	1,205	1,160	1,206	1,160	1,229
Oklahoma:												
State allowable [3]	481	484	506	525	538	525	526	576	563	560	558	595
Bureau of Mines estimate	481	484	506	525	538	553	570	576	563	560	558	567
Actual production	513	516	548	574	576	563	547	586	581	589	581	605
California:												
State allowable [4]	640	537	539	539	540	544	544	544	544	544	544	551
Bureau of Mines estimate	518	530	539	553	544	536	551	550	535	535	550	553
Actual production	680	587	566	573	577	582	575	578	579	579	582	584
Kansas:												
State allowable [5]	134	137	142	150	150	145	152	167	160	155	155	163
Bureau of Mines estimate	134	137	142	146	150	153	164	167	160	155	155	156
Actual production	144	139	155	164	156	152	160	169	167	166	166	174
Louisiana:												
State allowable [6]	169	181	187	202	213	217	225	230	235	235	238	238
Bureau of Mines estimate	133	141	151	161	171	176	187	189	186	189	199	205
Actual production	180	190	205	216	225	221	224	227	232	233	229	236
New Mexico:												
State allowable [7]	62	64	69	71	75	73	74	78	80	82	84	86
Bureau of Mines estimate	59	61	64	63	66	68	69	70	72	74	76	78
Actual production	62	65	69	70	75	73	74	75	76	82	83	87
Other States:												
Bureau of Mines estimate	217	227	233	226	224	226	229	230	224	222	223	226
Actual production	220	211	235	231	227	236	231	227	237	235	233	235
United States:												
Bureau of Mines estimate	2,559	2,648	2,739	2,797	2,826	2,838	2,917	2,937	2,864	2,842	2,870	2,930
Actual production	2,865	2,832	2,922	3,016	3,024	3,006	2,970	3,067	3,032	3,090	3,034	3,150

[1] The estimates of the Bureau of Mines start with July 1935, the data for the first 6 months of 1935 being the allocations of the Federal Agency under the Petroleum Code.

[2] Railroad Commission of Texas.

[3] Corporation Commission of Oklahoma.

[4] Central Committee of California Oil Producers.

[5] Corporation Commission of Kansas.

[6] Department of Conservation, Louisiana.

[7] Oil Conservation Commission of New Mexico.

153836—37——63

CRUDE PETROLEUM

Supply and demand.—The 10-percent increase in demand in 1936 over the previous year was due primarily to the growth in domestic consumption, particularly of motor fuel and heating oils. Data available for the first quarter of 1937 indicate further substantial increases in consumption, which will require a relatively greater increase in the new supply of crude oil if no further reduction in crude stocks occurs.

The total supply of crude petroleum in 1936 was approximately 1,157 million barrels—106 million barrels above the previous records set in 1929 and 1935. The domestic production of 1,099 million barrels was augmented by imports of 32 million barrels and by a withdrawal of 26 million barrels from crude stocks during the year. Compared with 1935 production increased by 102 million barrels, imports showed no appreciable change, and withdrawals from stocks were 4 million barrels greater.

The total demand for crude petroleum in 1936 equaled the supply, since there was no increase in crude stocks. Exports decreased from over 51 million barrels in 1935 to about 50 million in 1936. Domestic demand reached a new record of 1,107 million barrels in 1936. Runs of crude oil to stills totaled 1,068 million barrels, 80 million more than the previous record in 1929. Transfers of heavy crude to fuel-oil stocks, principally in California, increased to about 16 million barrels; and crude representing fuel consumed in production, pipe-line operation, and losses amounted to 23 million barrels.

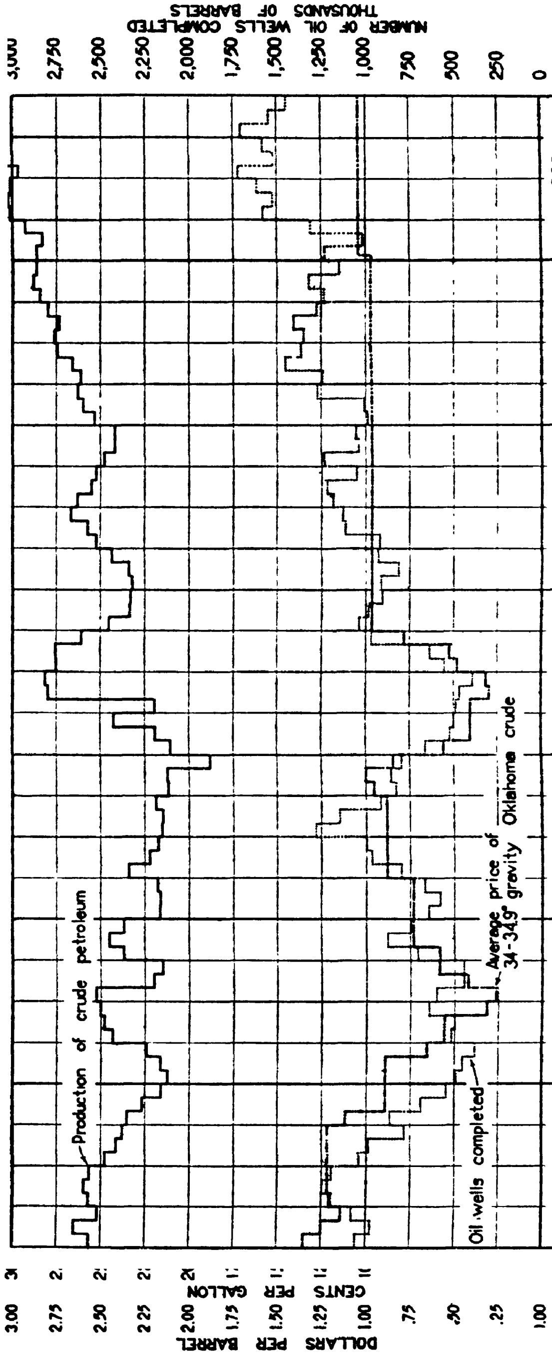
The relations between the daily average production of crude petroleum, the total number of oil wells completed, and the average price per barrel of a selected grade of Oklahoma crude petroleum from 1930 to 1936 are shown in figure 68.

Supply of and demand for crude petroleum, 1932–36

[Thousands of barrels of 42 gallons]

	1932	1933	1934	1935	1936 [1]
Production	785, 159	905, 656	908, 065	996, 596	1, 098, 516
Imports	44, 682	31, 893	35, 558	[2] 32, 239	[2] 32, 327
Changes in stocks east of California and in stocks of light crude in California	−30, 479	+15, 437	−16, 969	−22, 399	−26, 447
Total demand	860, 320	922, 112	960, 592	1, 051, 234	1, 157, 290
Runs to stills	819, 997	861, 254	895, 636	965, 790	1, 068, 134
Exports [3]	27, 393	36, 584	41, 127	51, 430	50, 184
Transfers to fuel-oil stocks in California	6, 603	7, 361	8, 382	13, 067	15, 732
Consumed as fuel on producing properties [4]	1, 701	1, 834	1, 523	1, 338	23, 240
Consumed as fuel in operation of pipe lines [4]	1, 454	1, 847	1, 835	1, 931	
Other fuel and losses, etc	3, 172	13, 232	12, 089	17, 678	
Total demand	860, 320	922, 112	960, 592	1, 051, 234	1, 157, 290

[1] Preliminary.
[2] As reported to the Bureau of Mines.
[3] Includes shipments to Alaska, Hawaii, and Puerto Rico.
[4] East of California.



—Daily average production of crude petroleum, total number of oil wells completed, and average price per barrel of a selected grade of Oklahoma crude petroleum, 1930–36, by months.

PRICES AND VALUES

The average value of crude petroleum at the wells increased from $0.97 per barrel in 1935 to $1.05 per barrel in 1936, according to a preliminary estimate. During the past 10 years this figure has ranged from a high point of $1.30 per barrel in 1927 to a low of $0.65 in 1931.

Taking the average for 1926 as 100, the Bureau of Labor Statistics price index for petroleum products was 50.5 in 1934, 51.3 in 1935, and 57.3 in 1936. The index rose from 54.4 percent of the 1926 average for January 1936 to 58.0 percent for December 1936.

The posted price of 36°–36.9° gravity crude in Oklahoma, generally accepted as a standard, advanced from $1 per barrel on January 1, 1936, to $1.10 on January 9 and remained at that level throughout the year.

Price changes during the year for selected grades of crude petroleum are shown in detail in the tables that follow, and certain longer-term changes by months from 1930–36 are shown in figure 69.

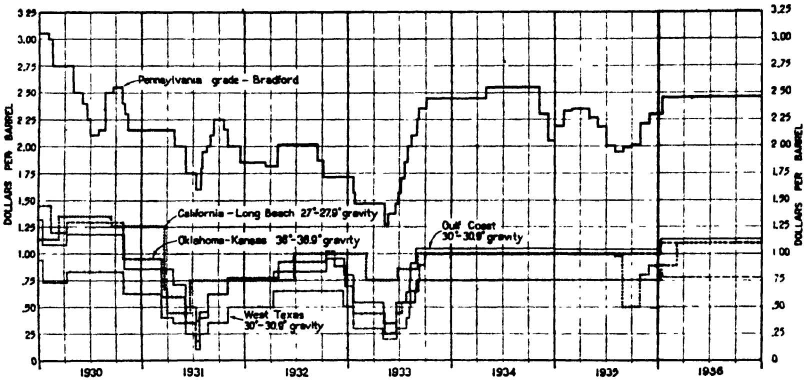


FIGURE 69.—Posted prices of selected grades of crude petroleum, 1930–36, by months.

Average monthly prices per barrel for selected grades of crude petroleum at wells in 1936

Month	Pennsylvania grade: Bradford	Pennsylvania grade: Southwest Pennsylvania	Lima, Ohio	Illinois	Oklahoma-Kansas 36°-36.9°	Panhandle, Tex. (Carson and Hutchinson Counties, 35°-35.9°)	West Texas	Gulf-coast grade B, 30°-30.9°	California (Long Beach, 27°-27.9°)
January	$2.39	$2.11	$1.22	$1.20	$1.07	$0.80	$0.78	$1.11	$0.90
February	2.45	2.17	1.25	1.23	1.10	.83	.78	1.14	.90
March	2.45	2.17	1.25	1.23	1.10	.83	.78	1.14	1.07
April	2.45	2.17	1.25	1.23	1.10	.83	.78	1.14	1.10
May	2.45	2.17	1.25	1.23	1.10	.83	.78	1.14	1.10
June	2.45	2.17	1.25	1.23	1.10	.83	.78	1.14	1.10
July	2.45	2.17	1.25	1.23	1.10	.83	.78	1.14	1.10
August	2.45	2.17	1.25	1.23	1.10	.83	.78	1.14	1.10
September	2.45	2.17	1.22	1.23	1.10	.83	.78	1.14	1.10
October	2.45	2.17	1.15	1.23	1.10	.83	.78	1.14	1.10
November	2.45	2.17	1.15	1.23	1.10	.83	.78	1.14	1.10
December	2.47	2.19	1.15	1.23	1.10	.83	.78	1.14	1.10
Average for year	2.45	2.17	1.22	1.23	1.10	.83	.78	1.14	1.06

Posted price per barrel of petroleum at wells in 1936, by grades, with dates of change

Date	Pennsylvania Grade: Bradford and Allegheny districts [1]	Pennsylvania Grade: In Southwest Pennsylvania pipe lines [2]	Corning Grade in Buckeye Pipe Line Co.[3]	Western Kentucky [3]	Lima, Ohio [3]	Illinois and Princeton, Ind.[3]	Midland, Mich.[4]	Oklahoma-Kansas [5]: 34°-34.9°	Oklahoma-Kansas [5]: 36°-36.9°
Jan. 1	$2.30	$2.02	$1.32	$1.13	$1.15	$1.13	$1.22	$0.96	$1.00
Jan. 9				1.23		1.23		1.06	1.10
Jan. 10					1.25				
Jan. 13	2.45	2.17	1.42						
Jan. 14							1.32		
June 15							1.42		
Sept. 16							1.32		
Sept. 22					1.15				
Nov. 1				1.28					
Dec. 28	2.57	2.32	1.32						
	2.45	2 17	1.42	1.24	1.22	1.23	1.34	1.06	1.10

Date	Panhandle, Tex. (Carson and Hutchinson Counties (35°-35.9°)[6]	West Texas [6]	Hobbs, N. Mex.[6]	Darst, Tex.[6]	Southwest Texas, Mirando [6]	Van, Tex., 34°-34.9° [4]	East Texas [7]	Gulf Coast: Conroe, 38°-38.9° [6]	Gulf Coast: Grade B, 30°-30.9° [8]
Jan. 1	$0 71	$0.75	$0 75	$0.87	$0.80	$0.90	$1.00	$1 15	$1.04
Jan. 9	.83	.85	.85	.97	.85	1.02	1.15	1.30	1.14
Jan. 14		.78	.78						
Nov. 1					.90				
	.83	.78	.78	.97	.86	1 02	1.15	1.30	1.15

Date	North Louisiana, 34°-34.9° [9]	Smackover, Ark. [9]	Salt Creek, Wyo., 36°-36.9° [10]	Sunburst, Mont.[3]	California [11]: Kettleman Hills, 38°-38.9°	California [11]: Long Beach, 27°-27.9°	California [11]: Midway-Sunset, 19°-19.9°	California [11]: Playa del Rey, 22°-22.9°	California [11]: Santa Fe Springs, 33°-33.9°
Jan. 1	$0.91	$0.70	$1 00	$1.20	$1.08	$0.90	$0.66	$0 84	$0 95
Jan. 9			1.10	1.25					
Jan. 10	.98								
Feb. 26					1.39		.74		
Mar. 7						1.10		.98	1.20
June 5				1.15					
	.98	.70	1.10	1.19	1.34	1.06	.73	.95	1.15

[1] The Tide-Water Pipe Co., Ltd.
[2] The Joseph Seep Purchasing Agency.
[3] The Ohio Oil Co.
[4] The Pure Oil Co.
[5] The Texas Co.
[6] Humble Oil & Refining Co.
[7] Magnolia Petroleum Co.
[8] Gulf Pipe Line Co.
[9] Standard Oil Co. of Louisiana.
[10] Stanolind Oil & Gas Co.
[11] Standard Oil Co. of California.

CONSUMPTION AND DISTRIBUTION

Runs to stills.—A new record was set in 1936 for crude run to stills, with a total of 1,068 million barrels, an increase of 102 million over 1935 and 80 million over the previous peak in 1929. Domestic crude runs contributed most of the increase in 1936, as foreign crude runs showed a gain of only 2 million barrels.

The greatest gains in crude runs, by districts, were 33 million barrels in the Texas Gulf Coast, 18 million in the Indiana-Illinois, 15 million in the East Coast, and 12 million in California. The Texas Gulf Coast district showed the greatest relative gain, from 21 percent of the total in 1935 to 22 percent in 1936. This district, together with Illinois-Indiana, exhibited the most consistent long-term expansion in volume of crude refined. In 1936, daily runs were the highest in September when the average was 3,029,000 barrels per day.

Crude runs to stills, 1934–36, by districts

District	1934		1935		1936 [1]	
	Thousands of barrels	Percent of total	Thousands of barrels	Percent of total	Thousands of barrels	Percent of total
East Coast	171,733	19.2	170,277	17.6	185,479	17.4
Appalachian	35,809	4.0	38,454	4.0	38,665	3.6
Indiana, Illinois, Kentucky, etc	119,166	13.3	129,798	13.4	147,724	13.8
Oklahoma, Kansas, and Missouri	95,006	10.6	107,672	11.1	114,667	10.7
Texas Inland	61,941	6.9	61,694	6.4	67,545	6.3
Texas Gulf Coast	179,418	20.0	200,606	20.8	233,258	21.8
Louisiana Gulf Coast	41,341	4.6	43,015	4.5	46,441	4.4
Arkansas and Louisiana Inland	18,850	2.1	17,416	1.8	23,874	2.2
Rocky Mountain	16,037	1.8	19,009	2.0	20,738	2.0
California	156,335	17.5	177,849	18.4	189,743	17.8
	895,636	100.0	965,790	100.0	1,068,134	100.0

[1] Preliminary.

Runs to stills of crude petroleum, 1935–36, by districts and months

[Thousands of barrels of 42 gallons]

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
1935													
East Coast:													
Domestic	11,612	11,746	11,889	11,469	12,346	11,888	12,280	12,641	12,257	12,075	12,006	12,141	144,350
Foreign	1,935	1,505	1,857	2,086	2,383	2,307	2,444	2,579	2,350	2,484	1,948	2,049	25,927
Total, East Coast	13,547	13,251	13,746	13,555	14,729	14,195	14,724	15,220	14,607	14,559	13,954	14,190	170,277
Appalachian	2,886	2,848	3,107	3,068	3,298	3,331	3,337	3,258	3,434	3,394	3,343	3,150	38,454
Indiana, Illinois, Kentucky, etc.	9,662	9,037	10,330	10,475	11,224	11,628	11,792	11,536	10,978	11,687	10,642	10,807	129,798
Oklahoma, Kansas, and Missouri	8,375	7,378	8,621	8,760	9,109	9,460	9,807	10,010	9,286	9,255	9,056	8,555	107,672
Texas Inland	4,552	4,740	4,979	4,526	4,958	5,100	5,420	5,677	5,805	5,464	5,450	5,023	61,694
Texas Gulf Coast:													
Domestic	16,126	14,860	16,135	14,573	14,790	16,350	17,346	16,467	16,537	16,926	17,348	18,538	195,996
Foreign	163	508	240	535	496	330	616	352	435	428	47	460	4,610
Total, Texas Gulf Coast	16,289	15,368	16,375	15,108	15,286	16,680	17,962	16,819	16,972	17,354	17,395	18,998	200,606
Louisiana Gulf Coast:													
Domestic	3,614	3,084	3,279	3,016	3,376	3,468	3,369	3,151	3,598	3,766	3,860	3,840	41,421
Foreign	14	57	63	212	76	126	220	203	102	254	131	136	1,594
Total, Louisiana Gulf Coast	3,628	3,141	3,342	3,228	3,452	3,594	3,589	3,354	3,700	4,020	3,991	3,976	43,015
Arkansas and Louisiana Inland	1,385	1,218	1,325	1,408	1,499	1,632	1,402	1,423	1,400	1,435	1,577	1,712	17,416
Rocky Mountain	1,284	1,241	1,449	1,535	1,692	1,698	1,754	1,912	1,719	1,646	1,650	1,429	19,009
California	13,738	12,486	13,323	13,403	15,130	14,278	15,078	15,375	15,446	16,318	16,122	17,152	177,849
Total domestic	73,234	68,638	74,437	72,233	77,422	78,833	81,585	81,450	80,460	81,966	81,054	82,347	933,659
Total foreign	2,112	2,070	2,160	2,833	2,955	2,763	3,280	3,134	2,887	3,166	2,126	2,645	32,131
Total United States: 1935	75,346	70,708	76,597	75,066	80,377	81,596	84,865	84,584	83,347	85,132	83,180	84,992	965,790
Total United States: 1934	71,512	66,470	71,807	73,563	76,258	76,054	80,065	79,928	73,611	75,991	73,784	76,593	895,636
Daily average, 1935	2,431	2,525	2,471	2,502	2,593	2,720	2,738	2,729	2,778	2,746	2,773	2,742	2,646

Runs to stills of crude petroleum, 1935–36, by districts and months—Continued

[Thousands of barrels of 42 gallons]

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
1936 [1]													
East coast:													
Domestic	12,267	12,141	12,741	11,844	12,610	13,045	12,955	12,862	13,139	13,055	13,457	14,529	154,645
Foreign	2,084	2,539	2,418	2,411	2,977	2,735	2,353	2,738	2,798	3,199	2,459	2,123	30,834
Total, East coast	14,351	14,680	15,159	14,255	15,587	15,780	15,308	15,600	15,937	16,254	15,916	16,652	185,479
Appalachian	3,172	2,975	2,939	3,200	3,308	3,249	3,323	3,360	3,296	3,246	3,238	3,359	38,665
Indiana, Illinois, Kentucky, etc	10,932	10,496	11,588	11,769	12,413	12,645	12,872	12,664	12,921	13,640	12,549	13,235	147,724
Oklahoma, Kansas, and Missouri	9,281	8,503	8,671	9,204	10,282	10,027	10,424	10,121	9,609	9,582	9,251	9,712	114,667
Texas Inland	5,474	4,923	5,295	5,153	5,314	5,478	6,110	6,589	5,866	5,727	5,811	5,805	67,545
Texas Gulf Coast:													
Domestic	19,110	17,829	18,606	18,315	19,325	18,108	19,331	19,883	19,932	20,646	20,091	20,971	232,147
Foreign	183	41	124	81	123	117	114	72	34	107	76	39	1,111
Total, Texas Gulf coast	19,293	17,870	18,730	18,396	19,448	18,225	19,445	19,955	19,966	20,753	20,167	21,010	233,258
Louisiana Gulf Coast:													
Domestic	3,610	3,605	3,636	3,581	3,709	3,586	3,754	3,878	3,554	3,837	3,778	3,925	44,453
Foreign	104	103	84	128	189	219	216	247	214	253	109	122	1,988
Total, Louisiana Gulf Coast	3,714	3,708	3,720	3,709	3,898	3,805	3,970	4,125	3,768	4,090	3,887	4,047	46,441
Arkansas and Louisiana Inland	1,529	1,796	1,751	1,986	2,109	1,904	2,057	2,112	1,997	2,297	2,095	2,241	23,874
Rocky Mountain	1,538	1,550	1,625	1,662	1,740	1,723	1,971	1,970	1,761	1,829	1,753	1,616	20,738
California	16,492	15,022	15,808	15,211	16,538	16,167	16,229	16,948	15,751	15,728	14,475	15,374	189,743
Total domestic	83,405	78,840	82,660	81,925	87,348	85,932	89,026	90,387	87,826	89,587	86,498	90,767	1,034,201
Total foreign	2,371	2,683	2,626	2,620	3,289	3,071	2,683	3,057	3,046	3,559	2,644	2,284	33,933
Total, United States: 1936	85,776	81,523	85,286	84,545	90,637	89,003	91,709	93,444	90,872	93,146	89,142	93,051	1,068,134
1935	75,346	70,708	76,597	75,066	80,377	81,596	84,865	84,584	83,347	85,132	83,180	84,992	965,790
Daily average, 1936	2,767	2,811	2,751	2,818	2,924	2,967	2,958	3,014	3,029	3,005	2,971	3,002	2,918

[1] Preliminary.

Distribution.—Important production of crude petroleum is concentrated in a relatively few States. Texas, California, and Oklahoma produced over 77 percent of the national total in 1936 and are credited with 81 percent of the proved reserves in an estimate, as of January 1, 1937, by a special committee of the American Petroleum Institute. This geographic concentration of reserves combined with widespread consumption results in the interstate movement of a very large proportion of either crude oil or its products.

Receipts of crude petroleum at refineries totaled 898 million barrels in 1934, 965 million in 1935, and 1,072 million in 1936. Intrastate receipts of domestic crude represented 56 percent of the total in 1936, while interstate receipts amounted to 41 percent and foreign receipts to 3 percent.

Receipts of crude by methods of transportation in 1936 indicated that 71 percent of the total was delivered by pipe lines, 27 percent by boat, and 2 percent by tank car and truck. The accompanying table shows receipts by methods of transportation for the last 3 years.

Receipts of crude petroleum at refineries, 1934–36, by methods of transportation

[In millions of barrels of 42 gallons]

	1934	1935	1936 [1]
By boat:			
Intrastate	42.5	55.4	68.7
Interstate	154.6	164.9	184.9
Foreign	35.6	32.2	32.3
Total by boat	232.7	252.5	285.9
By pipe lines:			
Intrastate	433.5	466.2	516.8
Interstate	205.9	220.9	247.1
Total by pipe lines	639.4	687.1	763.9
By tank car and truck:			
Intrastate	18.4	15 7	14.5
Interstate	7.5	9.7	7.7
Total by tank car and truck	25.9	25.4	22.2
Total receipts	898.0	965.0	1,072.0

[1] Preliminary.

Beginning with 1934, statistics are available on receipts of crude petroleum at refineries by States of origin. This movement constitutes the principal factor in market demand. The largest refinery receipts of domestic crude in 1936, 401 million barrels, were from Texas; Oklahoma ranked second with 205 million barrels, followed by California with 191 million, Louisiana with 72 million, Kansas with 60 million, and New Mexico with 30 million.

In considering the market demand for Texas crude oil, as indicated by receipts at refineries, the increase during the last 3 years has occurred in deliveries to local refineries, particularly in the Texas Gulf coast district. Intrastate deliveries increased from about 194 million barrels in 1934 to 236 million in 1936, and deliveries to refineries in other States declined from 171 million barrels in 1934 to 166 million in 1936. Receipts of Texas crude by refinery districts are indicated in the following table:

Receipts of Texas crude by refinery districts, 1934–36, in millions of barrels

District	1934	1935	1936
Texas	193.6	203.5	235.8
Louisiana	32.0	27.1	29.3
East Coast	119.8	116.9	118.6
Illinois-Indiana	11.1	10.9	10.2
All other	8.1	8.4	7.5
Total receipts	364.6	366.8	401.4
Exports	20.2	23.5	22.5

Oklahoma crude is widely distributed. In 1936 about 27 percent of the shipments went to local refineries and 73 percent to refineries in other States. Shipments exceeded production because of large withdrawals from storage during the year. Receipts of Oklahoma crude by refinery districts are shown in the table below.

Receipts of Oklahoma crude by refinery districts, 1934–36, in millions of barrels

District	1934	1935	1936
Oklahoma	50.4	53.2	55.1
Kansas-Missouri-Inland Texas	13.4	16.2	20.0
Gulf (Texas and Louisiana)	21.4	27.3	19.2
Illinois-Indiana	56.3	54.2	63.7
Michigan-Western Ohio-Kentucky and Tennessee	13.3	15.2	22.2
Appalachian	12.2	12.8	13.9
East Coast	6.7	10.1	10.6
Total receipts	173.7	189.0	204.7
Exports	6.9	7.3	7.6

Receipts of crude at refineries in California amounted to 159 million barrels in 1934, 180 million in 1935, and 191 million in 1936. Since no California crude was refined in other States, these figures represent total domestic receipts. Exports of crude amounted to 11 million barrels in 1934, 17 million in 1935, and 15 million in 1936. A considerable amount of heavy crude is used direct and transferred to fuel-oil stocks. These transfers amounted to over 8 million barrels in 1934, 13 million in 1935, and about 16 million in 1936.

Refinery receipts of Louisiana crude have increased from 31 million barrels in 1934 to almost 72 million in 1936. Deliveries to local refineries represented 34 percent of the total in 1936, and shipments to refineries in the Texas Gulf district amounted to about 45 percent of the total with most of the remainder going to East Coast district refineries. Receipts by refinery districts were as follows:

Receipts of Louisiana crude by refinery districts, 1934–36, in millions of barrels

District	1934	1935	1936
Louisiana	13.0	15.1	24.3
Texas Gulf	13.9	22.2	32.3
East Coast	4.1	6.1	14.4
All other	.2	.2	.6
Total receipts	31.2	43.6	71.6

About 56 percent of the crude oil produced in Kansas was delivered to local refineries in 1936, and the major part of the shipments outside the State went to refineries in Indiana and Illinois. Receipts of Kansas crude by refinery districts were as follows:

Receipts of Kansas crude by refinery districts, 1934–36, in millions of barrels

District	1934	1935	1936
Kansas	28.3	32.0	34.6
Illinois-Indiana	12.7	18.0	22.0
All other	3.0	3.9	3.6
Total receipts	44.0	53.9	60.2

The major part of the crude produced in New Mexico is widely distributed to refineries in other States. Receipts at the Gulf Coast district refineries of Texas and Louisiana rose from 6 million barrels in 1934 to 12 million in 1936. Shipments to East Coast district refineries amounted to 6 million barrels in 1934 and 8 million in 1936. The Illinois-Indiana refineries received 2 million barrels in 1934 and 6 million in 1936. Receipts for the last 3 years, by refinery districts, were as follows:

Receipts of New Mexico crude, by refinery districts, 1934–36, in millions of barrels

District	1934	1935	1936
New Mexico	1.1	1.2	1.4
Texas Gulf and Louisiana	6.0	5.9	12.3
East Coast	5.7	6.3	8.2
Illinois-Indiana	1.7	5.7	6.3
All other	2.8	1.4	1.9
Total receipts	17.3	20.5	30.1

Summary of crude-oil receipts and consumption at refineries in 1936

[Thousands of barrels of 42 gallons]

	Receipts at refineries						Change in refinery stocks	Crude runs to stills	Fuel and losses
	Intrastate	Interstate				Foreign			
		Oklahoma	Texas	Other	Total				
Arkansas	6,827		1,460	2	1,462		−189	8,441	37
California	191,253						−1,510	189,743	3,020
Colorado	648			422	422		−10	1,067	13
Georgia [2]			1,616		1,616	2,304	−328	4,238	10
Illinois	4,213	24,651	3,720	7,658	36,029		+405	39,803	34
Indiana		39,084	6,474	22,034	67,592		+456	67,154	−18
Kansas	34,642	13,503	134		13,637		+211	48,046	22
Kentucky [3]	5,395	1,631		252	1,883		−53	7,277	54
Louisiana [4]	24,342	1,255	30,392	5,257	36,904	1,875	+771	61,874	476
Maryland			7,695	2,293	9,988	3,996	−13	13,937	60
Massachusetts [5]			9,281	598	9,879	4,426	+326	13,954	25
Michigan	4,977	4,928			4,928		+59	9,808	38
Missouri		5,257	475	1,261	6,993		−48	7,041	
Montana	2,629			1,476	1,476		+71	4,033	1
New Jersey		4,875	39,556	14,096	58,527	5,055	−797	64,121	258
New Mexico	1,351		287		287		+10	1,624	4
New York	3,690	2,338	4,709	825	7,872	5,017	−262	16,841	
East			4,709		4,709	5,017	+50	9,676	
West	3,690	2,338		825	3,163		−312	7,165	
Ohio	2,476	23,839	1,468	6,390	31,697		+71	34,098	4
East	1,873	8,133		419	8,552		+9	10,416	
West	603	15,706	1,468	5,971	23,145		+62	23,682	4
Oklahoma	55,065		2,025	2,180	4,205		−512	59,580	202
Pennsylvania	14,644	7,721	55,913	11,746	75,380	8,630	+790	97,686	178
East		5,668	55,820	10,347	71,835	8,630	+749	79,553	163
West	14,644	2,053	93	1,399	3,545		+41	18,133	15
Texas	235,797	19,067		45,547	64,614	1,024	+465	300,803	167
Utah			383	2,260	2,643		−81	2,724	
West Virginia	1,286	1,353		310	1,663		−2	2,951	
Wyoming [6]	10,753						−606	11,290	69
Total United States	599,988	149,502	165,588	124,607	439,697	32,327	−776	1,068,134	4,654
Daily average	1,639	408	452	341	1,201	88	−2	2,918	12

[1] Preliminary.
[2] Includes Delaware, South Carolina, and Virginia.
[3] Includes Tennessee.
[4] Includes Alabama.
[5] Includes Rhode Island.
[6] Includes Nebraska and South Dakota.

Distribution of crude petroleum in 1936, by States [1]

[Thousands of barrels of 42 gallons]

State	Production	Imports	Receipts from other States		Runs to stills	Exports	Deliveries from other States		Net changes in total crude stocks by location
			Quantity	State			Quantity	State	
Arkansas	10,419		1,462	Louisiana and Texas	8,441		4,165	Louisiana, New Jersey, and Texas	−800
California	214,773				189,743	15,099			−4,755
Colorado	1,674		422	New Mexico and Wyoming	1,067		998	Utah	−28
Georgia		733	1,616	Texas	[2] 4,238				[2] −328
Illinois	4,445		36,029	Indiana, Kansas, Kentucky, Louisiana, New Mexico, Oklahoma, and Texas.	39,803	521	304	Kentucky and Ohio	−370
Indiana	798		67,592	Kansas, Louisiana, New Mexico, Oklahoma, and Texas.	67,154		867	Illinois and Kentucky	−207
Kansas	58,329		13,637	Oklahoma and Texas	48,046		25,622	Illinois, Indiana, Missouri, Ohio, Oklahoma, and West Virginia.	−3,938
Kentucky and Tennessee.	5,648		1,883	Illinois, Indiana, and Oklahoma	7,277		366	Illinois	+22
Louisiana	79,822	1,875	[3] 36,904	Arkansas, New Mexico, Oklahoma, and Texas.	[3] 61,874	306	47,297	Arkansas, Illinois, Indiana, Maryland, Massachusetts, New Jersey, Ohio, Pennsylvania, and Texas.	[3] +1,402
Maryland		3,996	9,988	Louisiana, New Mexico, and Texas	13,937				−13
Massachusetts		4,426	[4] 9,879	do	[4] 13,954				[4] +326
Michigan	11,828		4,928	Oklahoma	9,908	249	5,988	Ohio	+22
Missouri	(5)		6,993	Kansas, Oklahoma, and Texas	7,041				[6] +361
Montana	5,588		1,476	Wyoming	4,033	3,219			−99
New Jersey		5,055	58,527	Arkansas, Louisiana, New Mexico, New York, Oklahoma, Pennsylvania, Texas, and West Virginia.	64,121				−787
New Mexico	27,185		287	Texas	1,624		28,733	Colorado, Illinois, Indiana, Louisiana, Maryland, Massachusetts, New Jersey, Pennsylvania, Texas, and Utah.	+120
New York	4,663	5,017	7,872	Oklahoma and Pennsylvania	16,841		332	New Jersey and Pennsylvania	−232
Ohio	3,847		31,697	Illinois, Kansas, Louisiana, Michigan, Oklahoma, Texas, and West Virginia.	34,098		1,151	Pennsylvania and West Virginia	−335
Oklahoma	206,809		4,205	Kansas and Texas	59,580	7,580	149,502	Illinois, Indiana, Kansas, Kentucky, Louisiana, Michigan, Missouri, New Jersey, New York, Ohio, Pennsylvania, Texas, and West Virginia.	−8,437
Pennsylvania	17,070	8,630	75,380	Louisiana, New Mexico, New York, Ohio, Oklahoma, Texas, and West Virginia	97,686		4,751	New Jersey and New York	+978

South Carolina		579			(2)				(2)
Texas	427,280	1,024	64,614	Arkansas, Louisiana, New Mexico, and Oklahoma.	300,803	22,478	165,588	Alabama, Arkansas, Georgia, Illinois, Indiana, Kansas, Louisiana, Maryland, Massachusetts, Missouri, New Jersey, New Mexico, New York, Ohio, Oklahoma, Pennsylvania, Rhode Island, and Utah.	−7,909
Utah	(5)		2,643	Colorado, New Mexico, Texas, and Wyoming.	2,724				−81
Virginia		992			(2)				(2)
West Virginia	3,847		1,663	Kansas, Ohio, and Oklahoma	2,951		972	New Jersey, Ohio and Pennsylvania	−34
Wyoming	14,455				[7] 11,290	732	3,061	Colorado, Montana, and Utah	−1,325
Other States [6]	[5] 36								
	1,098,516	32,327	439,697		1,068,134	50,184	439,697		−26,447

[1] Preliminary. [2] Georgia includes Delaware, South Carolina, and Virginia. [3] Includes Alabama. [4] Massachusetts includes Rhode Island. [5] Missouri and Utah included under "Other States." [6] Includes Iowa and Nebraska. [7] Includes Nebraska and South Dakota.

STOCKS

The downward trend of stocks continued in 1936. The net decrease of 23.3 million barrels in the stocks of all oils in 1936 was due to a decline of 26.5 million in crude stocks. Natural-gasoline stocks increased 0.4 million barrels, and an increase of 2.8 million barrels is shown in the stocks of refined products. The stocks of all oils at the end of 1936 totaled 518.4 million barrels, or about 5 months' supply at the rate of demand prevailing during the year.

Stocks of crude petroleum decreased from 314.6 million barrels at the beginning of 1936 to 288.2 million at the end of the year. Producers' stocks increased by about 0.5 million barrels, pipe-line and tank-farm stocks decreased by 24.6 million, and refinery stocks decreased by 2.4 million.

During the year stocks of domestic crude decreased 4.7 million barrels in California and 20.1 million east of California, while stocks of foreign crude declined by 1.6 million barrels.

The most significant changes in crude stocks, on the basis of State origin, were decreases of 13.3 million barrels for Oklahoma crude, 9.0 million for Texas crude, and 4.7 million for California crude, and increases of 3.5 million for Louisiana crude and 2.0 million for New Mexico crude. The decreases represented liquidation of surplus and older stocks, and the increases were incident, in part, to increasing production and demand.

Increases in motor-fuel stocks included about 5.8 million barrels of finished gasoline, 0.4 million of natural gasoline, and of 0.5 million of unfinished gasoline. These increases were about in proportion to increased demand for motor fuel when measured in terms of days' supply.

Stocks of crude petroleum, natural gasoline, and refined products at the end of the year, 1932–36

[Thousands of barrels of 42 gallons, except as otherwise indicated]

	1932	1933	1934	1935	1936 [1]
Crude petroleum:					
At refineries [2]	61,769	66,049	64,099	59,148	56,757
Pipe line and tank farm	270,093	281,132 [3] 280,043	264,625	245,178	220,588
Producers	8,013	8,131	8,530	10,529 [3] 10,305	10,839
Total crude petroleum [4]	339,875	355,312 [3] 354,223	337,254	314,855 [3] 314,631	288,184
Natural gasoline	3,203	3,317 [3] 3,680	3,740 [3] 4,216	3,698	4,055
Refined products:					
Gasoline [5]	51,107	52,616 [3] 56,255	48,205 [3] 47,531	50,647	56,353
Kerosene	5,033	6,558	6,398	7,915	5,633
Gas oil and distillate fuel oils	14,277	17,025 [3] 16,315	21,957	19,930	22,719
Residual fuel oils [4]	116,476	106,475 [3] 106,689	88,440	84,054	84,199
Total gas oil and fuel oil [4]	130,753	123,500 [3] 123,004	110,397	103,984	106,918

See footnotes at end of table.

Stocks of crude petroleum, natural gasoline, and refined products at the end of the year, 1932–36—Continued

[Thousands of barrels of 42 gallons, except as otherwise indicated]

	1932	1933	1934	1935	1936
Refined products—Continued.					
Lubricants	8,694	7,100	7,331	7,025	6,942
Wax — thousands of pounds	163,935	69,117	136,136	114,675	115,434
Coke — thousands of short tons	1,330.2	727.4	405.1	388.9	389.4
Asphalt — do	276.1	254.5	339.2	429.7 [3] 405.4	368.3
Road oil	564	832	664	732 875	822
Other finished products	456	388 216	231	220	198
Crude gasoline	43,753	48,300	5,014	6,046	8,532
Other unfinished oils		[3] 45,046	40,738	42,074	38,411
Total refined products [6]	249,116	244,578 [3] 244,295	223,356 [3] 222,682	223,361 [3] 223,371	226,194
Grand total	592,194	603,207 [3] 602,198	564,350 [3] 564,152	541,914 [3] 541,700	518,433

[1] Preliminary.
[2] Includes foreign crude held by importers.
[3] For comparison with succeeding years.
[4] California heavy crude and fuel oil included under refined products as residual fuel oil.
[5] Includes pipe-line and bulk-terminal stocks.
[6] Includes equivalents for wax, coke, and asphalt in barrels.

Stocks of crude petroleum in 1936, by States of location

[Thousands of barrels of 42 gallons]

State	Jan. 1	Jan. 31	Feb. 29	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
Arkansas	4,314	4,162	4,102	4,149	4,252	4,335	4,113	3,884	3,962	3,980	3,904	3,694	3,514
California	38,944	40,640	40,275	39,856	39,338	38,878	37,856	36,781	35,476	34,123	33,901	33,815	34,189
Colorado	485	468	428	434	435	438	450	435	423	463	466	476	457
Georgia [1]	706	698	560	662	518	625	655	588	553	387	306	347	378
Illinois	11,630	11,614	11,358	11,248	10,992	11,111	10,750	10,972	11,097	11,207	10,904	11,083	11,260
Indiana	2,654	2,594	2,467	2,781	2,821	2,528	2,115	2,217	2,410	2,318	2,309	2,263	2,447
Kansas	12,171	12,075	11,874	11,880	12,072	11,677	11,020	10,316	9,568	9,311	8,813	8,457	8,233
Kentucky [2]	801	813	816	913	913	1,004	1,031	903	837	852	786	785	823
Louisiana [3]	9,099	9,464	9,797	10,269	10,331	10,283	10,525	10,887	10,715	10,707	10,668	10,627	10,501
Maryland	1,124	1,082	1,007	960	1,213	1,297	751	1,065	1,089	1,054	1,082	1,193	1,111
Massachusetts [4]	762	997	1,062	954	1,102	1,086	1,073	981	1,085	960	819	821	1,088
Michigan	744	745	741	1,008	1,093	1,117	1,044	1,056	946	946	935	869	766
Missouri [5]	3,454	3,365	3,304	3,490	3,584	3,520	3,662	3,586	3,645	3,656	3,699	3,532	3,508
Montana	1,127	1,208	1,274	1,286	1,370	1,283	1,336	1,234	1,141	1,044	1,020	963	1,028
New Jersey	6,051	6,343	6,064	5,810	5,819	6,293	6,066	5,794	5,459	5,326	6,058	5,044	5,264
New Mexico	709	653	705	742	727	751	789	788	783	770	820	801	829
New York	1,403	1,283	1,355	1,291	1,376	1,339	1,294	1,162	1,301	1,176	1,120	1,111	1,171
Ohio	7,375	7,419	7,326	7,315	7,465	7,482	7,200	7,149	7,077	7,029	7,172	7,122	7,040
Oklahoma	70,695	69,774	69,672	69,338	68,802	67,806	67,006	64,282	63,684	63,542	63,804	63,049	62,258
Pennsylvania	6,058	6,188	5,794	6,676	6,768	6,938	7,081	7,208	7,005	6,600	6,459	6,756	7,036
Texas	106,217	103,364	103,006	104,297	106,742	107,679	107,777	107,805	106,415	103,239	100,415	99,285	98,308
Utah	194	191	158	150	160	157	138	116	112	105	110	125	113
West Virginia	1,988	1,969	1,863	1,926	1,888	1,993	1,876	1,919	1,943	1,987	1,928	1,924	1,954
Wyoming [6]	25,926	25,972	25,804	25,754	25,608	25,549	25,438	25,262	25,031	24,911	24,773	24,856	24,908
Total, United States	314,631	313,081	310,812	313,189	315,389	315,169	311,046	306,390	301,757	295,693	292,271	288,998	288,184

[1] Includes Delaware, South Carolina, and Virginia.
[2] Includes Tennessee.
[3] Includes Alabama.
[4] Includes Rhode Island.
[5] Includes Iowa.
[6] Includes Nebraska and South Dakota.

Stocks of crude petroleum in 1936, by States of origin

[Thousands of barrels of 42 gallons]

State	Jan. 1	Jan. 31	Feb. 29	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
Arkansas	5,916	5,569	5,278	5,255	5,214	5,005	5,033	5,193	5,157	5,275	5,203	4,805	4,722
California	38,944	40,640	40,275	39,856	39,338	38,878	37,856	36,781	35,476	34,123	33,901	33,815	34,189
Colorado	551	403	344	337	338	347	379	403	408	419	508	502	486
Illinois	11,052	11,001	10,683	10,557	10,485	10,480	10,268	10,177	10,136	9,983	9,963	9,835	9,729
Indiana	44	51	52	79	78	58	47	47	46	45	46	46	46
Kansas	5,165	5,346	5,474	6,012	6,263	6,057	5,766	5,704	5,835	5,525	5,462	5,624	5,600
Kentucky	764	774	825	854	879	976	999	892	807	805	760	776	819
Louisiana	8,803	8,946	9,390	10,344	10,665	11,975	12,167	11,898	12,141	12,961	12,998	13,207	12,347
Michigan	895	978	864	999	1,107	1,138	1,105	1,173	1,122	968	1,010	966	809
Montana	1,108	1,189	1,265	1,266	1,347	1,272	1,331	1,211	1,121	1,026	1,003	922	993
New Mexico	5,573	5,614	5,638	5,992	6,123	6,221	6,154	6,420	6,587	6,779	7,044	7,690	7,596
New York	438	395	372	365	354	367	349	301	298	305	316	347	390
Ohio	1,117	1,072	1,149	1,220	1,247	1,167	1,066	1,007	925	782	822	818	956
Oklahoma	94,330	92,808	91,367	91,328	91,140	89,888	87,852	84,619	83,358	82,668	81,334	81,228	80,989
Pennsylvania	2,303	2,230	2,162	2,220	2,388	2,285	2,369	2,334	2,255	2,339	2,377	2,375	2,275
Texas	106,079	104,839	104,705	105,689	107,576	108,459	108,421	108,549	106,663	102,529	101,223	97,527	97,145
West Virginia	1,752	1,756	1,703	1,778	1,720	1,781	1,665	1,694	1,738	1,780	1,778	1,742	1,783
Wyoming	26,052	26,225	26,050	26,009	25,869	25,798	25,642	25,427	25,172	25,074	24,849	24,985	25,193
Foreign	3,745	3,245	3,216	3,029	3,258	3,017	2,577	2,560	2,512	2,307	1,674	1,788	2,117
Total United States	314,631	313,081	310,812	313,189	315,389	315,169	311,046	306,390	301,757	295,693	292,271	288,998	288,184

Stocks of crude petroleum in 1936, by districts and months

[Thousands of barrels of 42 gallons]

District	Jan. 1	Jan. 31	Feb. 29	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec 31
At refineries, by location of storage:													
East coast:													
Domestic	9,173	10,217	9,738	10,364	10,340	11,227	10,898	10,794	10,326	9,661	10,435	9,966	10,571
Foreign	2,976	2,605	2,510	2,395	2,596	2,473	2,088	2,089	2,172	1,901	1,428	1,355	1,565
Appalachian	1,270	1,194	1,115	1,114	1,116	1,111	1,042	1,067	1,015	972	1,135	1,095	1,007
Indiana, Illinois, Kentucky, etc	2,912	3,125	2,975	3,404	3,390	3,417	2,995	3,355	3,403	3,507	3,347	3,683	3,840
Oklahoma, Kansas, and Missouri	4,348	4,193	4,215	4,693	4,913	4,786	4,662	4,593	4,586	4,287	4,164	4,052	3,999
Texas inland	1,705	1,659	1,707	1,864	2,016	1,975	2,175	1,996	1,844	1,710	1,618	1,473	1,380
Texas Gulf coast:													
Domestic	10,439	9,515	9,414	11,203	11,896	12,375	13,053	12,772	12,098	12,095	11,370	10,936	11,320
Foreign	268	175	129	145	131	150	101	57	54	84	48	146	177
Louisiana Gulf coast:													
Domestic	2,045	2,179	2,142	2,706	2,589	2,643	2,901	2,910	2,985	2,931	2,902	2,782	2,897
Foreign	501	465	577	489	531	394	388	414	286	322	198	287	375
Arkansas and Louisiana Inland	943	915	867	1,057	1,180	1,127	1,107	1,072	1,066	1,035	1,112	931	799
Rocky Mountain	12,509	12,547	12,297	12,307	12,355	12,311	12,218	12,102	11,856	11,964	11,847	11,797	11,893
California	8,444	9,337	8,600	8,878	8,849	7,988	7,984	8,163	7,752	7,891	7,850	7,170	6,934
Total at refineries	57,533	58,126	56,286	60,619	61,902	61,977	61,612	61,384	59,443	58,360	57,454	55,673	56,757
At refineries, by fields of origin:													
Appalachian:													
Pennsylvania grade	1,164	1,094	1,018	947	1,009	921	909	860	805	839	863	846	680
Other Appalachian (including Kentucky)	473	434	441	421	516	575	583	483	433	479	423	421	450
Lima-Northeastern Indiana-Michigan	336	351	243	219	272	178	183	275	271	197	246	309	239
Illinois-Southwestern Indiana	80	113	107	130	95	95	93	76	89	75	103	105	99
North Louisiana and Arkansas	1,986	1,851	1,464	1,845	2,350	2,145	2,298	2,372	2,351	2,584	2,776	2,528	1,987
West Texas and Southeastern New Mexico	3,411	3,776	3,411	4,698	4,110	4,374	4,637	4,958	3,941	3,765	4,068	4,123	4,508
East Texas	4,818	4,854	5,488	5,702	5,227	5,431	5,248	5,134	5,500	5,397	4,974	4,604	4,860
Oklahoma, Kansas, North Texas, etc	12,810	12,277	12,131	13,624	14,613	15,049	14,628	14,794	14,691	13,845	14,113	13,591	14,460
Gulf coast	7,787	8,275	7,886	8,835	9,269	9,907	10,274	9,629	9,202	9,039	8,541	8,420	8,560
Rocky Mountain	12,479	12,519	12,281	12,291	12,334	12,297	12,198	12,080	11,896	11,942	11,823	11,768	11,863
California	8,444	9,337	8,600	8,878	8,849	7,988	7,984	8,163	7,752	7,891	7,850	7,170	6,934
Foreign	3,745	3,245	3,216	3,029	3,258	3,017	2,577	2,560	2,512	2,307	1,674	1,788	2,117
Total at refineries	57,533	58,126	56,286	60,619	61,902	61,977	61,612	61,384	59,443	58,360	57,454	55,673	56,757

Pipe-line and tank-farm stocks, by fields of origin:													
Appalachian:													
Pennsylvania grade	3,435	3,348	3,324	3,546	3,623	3,615	3,620	3,581	3,560	3,600	3,634	3,604	3,644
Other Appalachian (including Kentucky)	424	472	551	623	578	576	580	559	515	436	460	507	565
Lima-Northeastern Indiana-Michigan	959	1,003	999	1,181	1,214	1,357	1,184	1,149	1,067	943	950	838	793
Illinois-Southwestern Indiana	10,888	10,816	10,509	10,407	10,367	10,331	10,113	10,051	9,981	9,845	9,798	9,655	9,577
North Louisiana and Arkansas	7,690	7,726	7,952	8,281	8,310	8,578	8,744	8,833	8,946	9,391	8,867	8,839	8,935
West Texas and Southeastern New Mexico	26,098	25,612	25,474	24,563	25,103	24,793	24,336	24,406	25,054	24,951	24,760	25,258	24,098
East Texas	16,771	16,136	16,020	16,577	16,997	17,403	17,378	18,033	17,608	16,192	15,828	15,198	15,814
Oklahoma, Kansas, North Texas, etc.	120,074	118,755	117,453	116,217	115,886	114,065	112,237	108,798	107,113	105,415	103,654	103,114	102,193
Gulf coast	18,581	17,733	18,568	18,118	18,717	19,348	19,106	18,949	18,828	18,692	19,117	17,804	16,683
Rocky Mountain	14,772	14,805	14,900	14,838	14,712	14,595	14,628	14,433	14,322	14,035	14,052	14,132	14,284
California	27,101	28,510	28,929	28,342	27,890	28,081	26,992	25,798	24,672	23,146	22,800	23,526	24,002
Total pipe-line and tank-farm	246,793	244,916	244,679	242,693	243,397	242,742	238,918	234,590	231,666	226,646	223,920	222,475	220,588
Producer's stocks	10,305	10,039	9,847	9,877	10,090	10,450	10,516	10,416	10,648	10,687	10,897	10,850	10,839
Total United States: 1936	314,631	313,081	310,812	313,189	315,389	315,169	311,046	306,390	301,757	295,693	292,271	288,998	288,184
1935	337,254	338,199	337,349	339,179	339,823	338,619	334,841	329,459	325,106	320,880	317,955	315,779	314,855

WELLS

Drilling again gained materially, 25,166 completions (18 percent more than in 1935) being recorded in 1936. Data on the number of producing wells at the close of 1936 are not available, but indications are that the total will increase from 340,990 on January 1 to about 350,000 on December 31, 1936.

Of continued interest was the decrease in the ratio of failures. (See fig. 70.) Although the number of dry holes increased from 4,911 in 1935 to 5,296 in 1936, the percentage of total completions declined from 23 percent in 1935 to 21 percent in 1936. This ratio was the lowest in nearly 20 years.

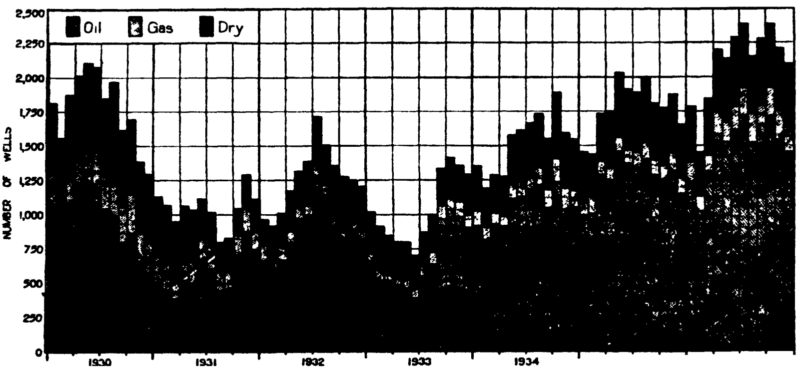


FIGURE 70.—Wells drilled, 1930–36, by months.

Although drilling in 1936 declined 42 percent from 1935 in the East Texas field the field still continued to lead all others in total footage by a wide margin. There were actually more completions in the Bradford-Allegany field in 1936 than there were in East Texas, but 723 of the Bradford-Allegany completions were water wells drilled under the five-spot program. The little known Loma Novio field of south Texas ranked third in completions. Other areas that were actively explored by the drill in 1936 were Young County, Tex.; Lea County, N. Mex.; and the Fitts and Rodessa fields.

Wells drilled for oil and gas in the United States in 1936, by months

Wells	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total: Number	Total: Percent
Oil	1,236	1,018	1,308	1,580	1,522	1,612	1,718	1,521	1,583	1,708	1,545	1,449	17,800	70.7
Gas	140	109	118	161	139	169	206	208	212	209	214	185	2,070	8.2
Dry	406	318	413	456	467	506	463	417	477	466	449	458	5,296	21.1
Total: 1936	1,782	1,445	1,839	2,197	2,128	2,287	2,387	2,146	2,272	2,383	2,208	2,092	25,166	100.0
1935	1,464	1,449	1,744	1,749	2,046	1,913	1,894	2,001	1,821	1,787	1,884	1,668	21,420	------

Oil and gas wells in 1935

State and district	Producing oil wells		Wells drilled [1]				
	Approximate number, Dec. 31	Average production per well per day (barrels)	Oil	Gas	Dry	Total	Estimated average daily initial production per well (barrels)
Arkansas	2,680	11.1	40	2	73	115	207
California [2]	12,780	46.4	729	34	347	1,110	907
Colorado	200	21.9	11	1	6	18	906
Illinois	14,330	.8	5		6	11	68
Indiana:							
Southwestern	1,125	1.8	34	62	77	173	21
Northeastern	95	.6	3	12	9	24	15
Total Indiana	1,220	1.7	37	74	86	197	20
Kansas	19,250	7.9	890	39	281	1,210	950
Kentucky	13,800	1.0	167	16	70	253	41
Louisiana:							
Gulf Coast	710	175.9	220	6	128	354	721
Northern	2,690	9.9	124	98	121	343	1,523
Total Louisiana	3,400	42.2	344	104	249	697	1,010
Michigan	1,160	40.4	322	103	168	593	560
Montana	1,650	8.3	131	17	38	186	99
New Mexico	840	75.8	262	4	71	337	2,331
New York	19,600	.6	(3)	(3)	(3)	(3)	(3)
Ohio:							
Central	20,000	.4	256	216	170	642	15
Northwestern	12,100	.2	43	29	22	94	14
Total Ohio	32,100	.3	299	245	192	736	15
Oklahoma	54,600	9.1	1,321	110	579	2,010	874
Pennsylvania	82,050	.5	[3] 1,956	[3] 61	[3] 45	[3] 2,062	[3] 1
Texas:							
Gulf Coast	4,220	44.9	804	56	311	1,171	427
East Texas proper	19,520	27.7	4,033	5	128	4,166	[4] 1,590
West Texas	4,080	40.2	653	9	122	784	502
Rest of State	31,290	8.6	2,931	206	1,977	5,114	275
Total Texas	59,110	19.3	8,421	276	2,538	11,235	937
West Virginia	18,710	.6	115	304	114	533	11
Wyoming	3,380	11.1	58	6	28	92	674
Other	[5] 130			5	20	[6] 25	
Total wells	340,990	8.1	15,108	1,401	4,911	21,420	780

[1] From Oil and Gas Journal, except California.
[2] From American Petroleum Institute.
[3] New York included with Pennsylvania.
[4] Based on short gages generally ranging from 15 to 30 minutes.
[5] Mississippi, Missouri, Tennessee, and Utah.
[6] Alabama, Mississippi, Missouri, Tennessee, and Utah.

Drilling activity in leading districts, 1935–36

District	State	Completions 1935	Completions 1936	District	State	Completions 1935	Completions 1936
Barton County	Kans.	29	159	Pontotoc County	Okla.	277	423
Bradford-Allegany	Pa.-N. Y.	1,650	2,702	Reno County	Kans.	156	169
Caddo Parish	La.	134	363	Rice County	do.	203	310
Cass County	Tex.	3	164	Russell County	do.	177	263
Cooke County	do.	193	360	Samfordyce	Tex.	104	73
East Texas	do.	4,150	2,425	Saxet	do.	46	274
Gillis	La.	39	45	Saxet Heights	do.	2	226
Glacier County	Mont.	113	126	Seminole County	Okla.	211	268
Lea County	N. Mex.	265	485	Seven Sisters	Tex.	45	333
Loma Novio	Tex.	201	464	Tomball	do.	108	80
Lopez	do.	27	250	Tepetate	La.	5	40
McLean County	Ky.	24	180	Ward County	Tex.	172	333
Montcalm County	Mich.	156	246	Winkler County	do.	105	401
O'Hern	Tex.	40	118	Young County	do.	424	572

PRODUCTION

In the first 7 or 8 months of 1936 the production of crude petroleum kept pace with the demand for gasoline, the total output showing a more or less steady increase during that period. The daily average production in January 1936 was 2,865,000 barrels, in April the 3,000,000-barrel mark was passed, and in August the daily average reached 3,067,000 barrels. In the closing months of the year the demand for gasoline declined, because of the usual seasonal influences, but crude runs to stills showed little change in anticipation of an active fuel-oil demand. This situation, combined with the pressure of shut-in production to find a market, prevented the late-season decline in crude-oil production that was the characteristic trend prior to the last 2 or 3 years. Production accordingly continued to increase in the last quarter of the year, and the highest daily average output—3,150,000 barrels—was recorded in December.

Production of crude petroleum in 1936,[1] by States and months

[Thousands of barrels of 42 gallons]

State and district	January	February	March	April	May	June	July	August	September	October	November	December	1936	1935
Arkansas	889	846	928	899	934	878	899	854	829	842	793	828	10,419	11,008
California:[2]														
Huntington Beach	1,278	1,077	1,108	1,072	1,099	1,085	1,104	1,099	1,084	1,093	1,053	1,095	13,247	15,133
Kettleman Hills	3,013	2,329	2,399	2,355	2,435	2,345	2,420	2,478	2,338	2,424	2,336	2,414	29,286	27,607
Long Beach	2,413	2,068	2,167	2,073	2,097	2,041	2,076	2,067	2,028	2,031	1,962	1,971	24,994	26,563
Santa Fe Springs	1,666	1,283	1,332	1,293	1,358	1,322	1,374	1,401	1,329	1,371	1,355	1,376	16,460	16,159
Rest of State	12,713	10,278	10,535	10,387	10,887	10,652	10,836	10,880	10,596	11,023	10,756	11,243	130,786	122,370
Total California	21,083	17,035	17,541	17,180	17,876	17,445	17,810	17,925	17,375	17,942	17,462	18,099	214,773	207,832
Colorado	130	112	135	159	142	147	147	155	155	151	123	118	1,674	1,560
Illinois	325	294	396	347	389	383	402	380	386	393	363	387	4,445	4,322
Indiana	60	53	66	66	69	74	73	66	69	70	61	71	798	777
Kansas	4,459	4,020	4,815	4,908	4,823	4,559	4,968	5,231	5,008	5,157	4,992	5,389	58,329	54,843
Kentucky	410	391	483	459	458	463	492	485	504	516	475	492	5,628	5,258
Louisiana:														
Gulf Coast	4,014	3,831	4,253	4,312	4,400	4,313	4,557	4,506	4,536	4,812	4,526	4,817	52,877	40,776
Rodessa	893	1,062	1,392	1,506	1,911	1,667	1,732	1,856	1,780	1,716	1,709	1,815	19,039	1,353
Rest of State	663	613	697	655	655	662	648	664	649	696	636	668	7,906	8,201
Total Louisiana	5,570	5,506	6,342	6,473	6,966	6,642	6,937	7,026	6,965	7,224	6,871	7,300	79,822	50,330
Michigan	1,264	1,043	1,143	977	1,002	971	1,010	949	866	908	850	845	11,828	15,776
Montana	374	320	485	510	515	523	431	435	502	470	507	516	5,588	4,603
New Mexico	1,915	1,887	2,148	2,088	2,331	2,159	2,280	2,331	2,285	2,540	2,493	2,698	27,185	20,483
New York	364	340	376	379	386	380	391	392	396	419	394	446	4,663	4,236
Ohio	279	246	359	349	341	347	338	325	326	329	285	323	3,847	4,082
Oklahoma:														
Oklahoma City	4,433	4,232	4,427	4,653	4,652	4,196	4,423	4,964	4,454	4,876	4,708	5,156	55,174	54,205
Seminole	4,050	3,888	4,348	4,496	4,604	4,280	4,223	4,368	4,040	4,287	4,141	4,262	50,987	47,688
Rest of State	7,419	6,828	8,214	8,077	8,586	8,419	8,306	8,846	8,941	9,096	8,566	9,350	100,648	83,395
Total Oklahoma	15,902	14,948	16,989	17,226	17,842	16,895	16,952	18,178	17,435	18,259	17,415	18,768	206,809	185,288
Pennsylvania	1,323	1,220	1,382	1,387	1,409	1,447	1,474	1,455	1,479	1,547	1,414	1,533	17,070	15,810

[1] Preliminary.
[2] American Petroleum Institute.

Production of crude petroleum in 1936, by States and months—Continued

[Thousands of barrels of 42 gallons]

State and district	January	February	March	April	May	June	July	August	September	October	November	December	1936	1935
Texas:														
Gulf Coast	6,154	6,169	6,946	7,076	7,461	7,091	7,452	7,746	7,303	7,906	6,935	8,044	86,283	64,914
West Texas	4,473	4,620	5,284	5,348	5,478	5,135	5,435	5,469	5,081	5,452	4,793	5,333	61,901	55,417
East Texas	14,241	13,746	14,410	14,334	14,535	13,999	13,787	14,482	13,260	13,840	13,441	13,971	168,046	176,859
Panhandle	1,821	1,736	1,881	1,888	1,905	1,839	1,889	1,908	1,838	2,049	1,805	1,912	22,471	21,369
Rest of State	6,368	6,329	6,935	6,982	7,448	7,297	7,357	7,732	7,330	8,125	7,838	8,835	88,579	74,107
Total Texas	33,057	32,600	35,456	35,628	36,827	35,361	35,920	37,337	34,812	37,372	34,812	38,098	427,280	392,666
West Virginia	296	296	320	336	323	333	337	313	328	336	289	340	3,847	3,902
Wyoming:														
Salt Creek	519	460	529	517	507	510	520	494	494	514	489	517	6,070	6,257
Rest of State	597	499	671	587	594	633	692	754	753	801	925	879	8,385	7,498
Total Wyoming	1,116	959	1,200	1,104	1,101	1,143	1,212	1,248	1,247	1,315	1,414	1,396	14,455	13,755
Other [3]	4	4	4	4	5	5	5	5	5	5	5	5	56	65
Total United States, 1936	88,820	82,120	90,568	90,479	93,739	90,185	92,078	95,090	90,972	95,795	91,018	97,652	1,098,516	-------
Total United States, 1935	78,720	72,802	81,650	78,723	82,564	82,652	85,709	85,032	84,458	88,577	86,752	88,957	-------	996,596
Daily average, 1936	2,865	2,832	2,922	3,016	3,024	3,006	2,970	3,067	3,032	3,090	3,034	3,150	3,001	2,730

[3] Mississippi, Missouri, Tennessee, and Utah.

Production increased in 1936 in all of the major districts except Lima-northeastern Indiana-Michigan. The Gulf coast district, comprising parts of both Texas and Louisiana, showed the largest percentage gain in output in 1936 of any of the districts. The production of Pennsylvania grade crude, which accounts for nearly three-fourths of the output in the Appalachian district, totaled 27,072,000 barrels in 1936, an increase of 6 percent over 1935.

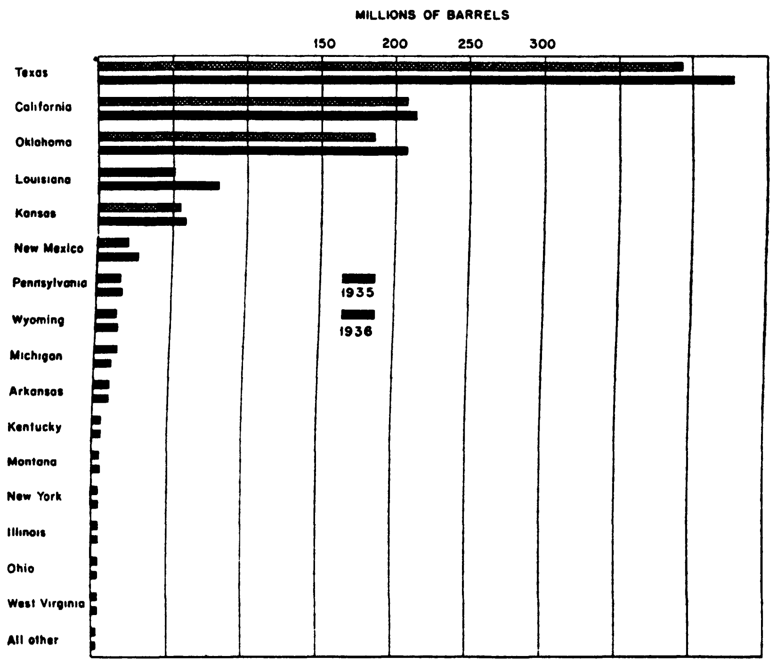


FIGURE 71.—Production of crude petroleum, 1935–36, by States.

Texas retained its rank as the leading producing State, although its share in the national total was slightly less than in 1935. Oklahoma's share increased slightly from the low point of 1935, but California produced somewhat less than 20 percent of the total in 1936 compared with nearly 21 percent in 1935. The loss in percentage accounted for by the three leading States was more than compensated by gains in Louisiana and New Mexico. Louisiana, with a 59-percent gain in production in 1936, passed Kansas to take fourth place among the producing States.

The relative rank of the producing States is shown graphically in figure 71.

Percentage of crude petroleum produced by principal States, 1929–36

	1929	1930	1931	1932	1933	1934	1935	1936
Texas	29.5	32.4	39.1	39.8	44.5	42.0	39.4	38.9
California	29.0	25.3	22.2	22.7	19.0	19.2	20.9	19.6
Oklahoma	25.3	24.1	21.2	19.5	20.1	19.9	18.6	18.8
Total, 3 States	83.8	81.8	82.5	82.0	83.6	81.1	78.9	77.3
Kansas	4.3	4.7	4.4	4.4	4.6	5.1	5.5	5.3
Louisiana	2.0	2.6	2.6	2.8	2.8	3.6	5.0	7.3
New Mexico	.2	1.1	1.8	1.6	1.6	1.9	2.1	2.5
Michigan	.4	.4	.4	.9	.9	1.2	1.5	1.1
Pennsylvania	1.2	1.4	1.4	1.6	1.4	1.6	1.6	1.5
Arkansas	2.5	2.2	1.7	1.5	1.3	1.1	1.1	.9
All other	5.6	5.8	5.2	5.2	3.8	4.4	4.3	4.1
Total, United States	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Despite a decline in production in 1936, the east Texas field easily retained first place among the producing pools. Oklahoma City, Seminole, and Kettleman Hills retained second, third, and fourth places, respectively. The new entries into the list of the 10 leading fields in 1936 were Rodessa and Fitts, displacing Conroe and Pecos County (mostly Yates), Tex.

Production of crude oil in leading fields in 1936, in barrels

Field	1936	Approximate increase or decrease compared with 1935
East Texas, Tex	168,046	−8,813
Oklahoma City, Okla	55,174	+969
Seminole, Okla	50,987	+3,299
Kettleman Hills, Calif	29,287	+1,680
Long Beach, Calif	24,994	−1,569
Rodessa, La.-Tex	23,130	+21,765
Midway-Sunset, Calif	21,482	+1,242
Fitts, Okla.[1]	19,908	+13,007
Bradford-Allegany, Pa.-N. Y	18,546	+1,748
Santa Fe Springs, Calif	16,460	+301
Conroe, Tex.[1]	14,909	−360
Pecos County, Tex.[1]	14,003	−2,469
Van, Tex.[1]	13,339	−926
Huntington Beach, Calif	13,247	−1,886
Ventura Ave., Calif	12,610	+1,631
All other	602,394	+72,301
Total, United States	1,098,516	+101,920

[1] Oil and Gas Journal.

Petroleum produced in the United

[Thousands of barrels

Year	New York	Pennsylvania	Ohio	West Virginia	California	Kentucky	Colorado	Indiana	Illinois	Kansas	Texas
1859-75	(2)	[2] 74,072	------	------	------	------	------	------	------	------	------
1876	(2)	[2] 8,969	32	120	12	------	------	------	------	------	------
1877	(2)	[2] 13,135	30	172	13	------	------	------	------	------	------
1878	(2)	[2] 15,164	38	180	15	------	------	------	------	------	------
1879	(2)	[2] 19,685	29	180	20	------	------	------	------	------	------
1880	(2)	[2] 26,028	39	179	40	------	------	------	------	------	------
1881	(2)	[2] 27,376	34	151	100	------	------	------	------	------	------
1882	6,685	23,368	40	128	129	------	------	------	------	------	------
1883	4,004	19,125	47	126	143	[3] 5	------	------	------	------	------
1884	3,231	20,541	90	90	262	[3] 4	------	------	------	------	------
1885	2,658	18,118	662	91	325	[3] 5	------	------	------	------	------
1886	2,151	23,647	1,783	102	377	[3] 5	------	------	------	------	------
1887	2,075	20,281	5,023	145	678	[3] 5	76	------	------	------	------
1888	(2)	[2] 16,489	10,011	119	690	[3] 5	298	------	------	------	------
1889	1,897	19,591	12,472	544	303	[3] 5	317	33	1	1	(4)
1890	(2)	[2] 28,458	16,125	493	307	[3] 6	369	64	1	1	(4)
1891	1,585	31,424	17,740	2,406	324	[3] 9	666	137	1	1	(4)
1892	1,273	27,149	16,363	3,810	385	[3] 7	824	698	1	5	(4)
1893	1,032	19,283	16,249	8,446	470	[3] 3	594	2,335	1	18	(4)
1894	942	18,078	16,792	8,577	706	[3] 2	516	3,689	(4)	40	(4)
1895	913	18,231	19,545	8,120	1,209	[3] 2	438	4,386	(4)	44	(4)
1896	1,205	19,379	23,941	10,020	1,253	[3] 2	361	4,681	(4)	114	1
1897	1,279	17,983	21,561	13,090	1,903	(3 4)	385	4,122	1	81	66
1898	1,205	14,743	18,739	13,615	2,257	[3] 6	444	3,731	(4)	72	546
1899	1,321	13,054	21,142	13,911	2,642	[3] 18	390	3,848	(4)	70	669
1900	1,301	13,258	22,363	16,196	4,325	[3] 62	317	4,874	(4)	75	836
1901	1,207	12,625	21,648	14,177	8,787	[3] 137	461	5,757	(4)	179	4,394
1902	1,120	12,064	21,014	13,513	13,984	[3] 185	397	7,481	(4)	332	18,084
1903	1,163	11,355	20,480	12,900	24,382	[3] 554	484	9,186	------	932	17,956
1904	1,113	11,126	18,877	12,645	29,649	[3] 998	501	11,339	------	4,251	22,241
1905	1,118	10,437	16,347	11,578	33,428	[3] 1,217	376	10,964	181	[6] 12,014	28,136
1906	1,243	10,257	14,788	10,121	33,099	[3] 1,214	328	7,674	4,397	[6] 21,718	12,568
1907	1,212	10,000	12,207	9,095	39,748	[3] 821	332	5,128	24,282	2,410	12,323
1908	1,160	9,424	10,859	9,523	44,855	728	380	3,283	33,686	1,801	11,207
1909	1,135	9,299	10,633	10,745	55,472	639	311	2,296	30,898	1,264	9,534
1910	1,054	8,795	9,916	11,753	73,011	469	240	2,160	33,143	1,128	8,899
1911	953	8,248	8,817	9,796	81,134	472	227	1,695	31,317	1,279	9,526
1912	874	7,838	8,969	12,129	87,269	484	206	970	28,602	1,593	11,735
1913	948	7,917	8,781	11,567	97,788	525	189	956	23,894	2,375	15,010
1914	939	8,170	8,536	9,680	99,775	503	223	1,336	21,920	3,104	20,068
1915	888	7,838	7,825	9,265	86,592	437	208	876	19,042	2,823	24,943
1916	874	7,593	7,744	8,731	90,952	1,202	197	769	17,714	8,738	27,645
1917	880	7,733	7,751	8,379	93,878	3,088	121	760	15,777	36,536	32,413
1918	809	7,408	7,285	7,867	97,532	4,368	143	878	13,366	45,451	38,750
1919	851	8,137	7,736	8,327	101,183	9,278	121	972	11,960	33,048	79,366
1920	906	7,438	7,400	8,249	103,377	8,738	111	945	10,774	39,005	96,868
1921	988	7,418	7,335	7,822	112,600	9,013	108	1,158	10,043	36,456	106,166
1922	1,000	7,425	6,781	7,021	138,468	8,973	97	1,087	9,383	31,766	118,684
1923	1,250	7,609	7,085	6,358	262,876	8,069	86	1,043	8,707	28,250	131,023
1924	1,440	7,486	6,811	5,920	228,933	7,407	445	935	8,081	28,836	134,522
1925	1,695	8,097	7,212	5,763	232,492	6,759	1,226	829	7,863	38,357	144,648
1926	1,956	8,961	7,272	5,946	224,673	6,274	2,768	808	7,760	41,498	166,916
1927	2,242	9,526	7,593	6,023	231,196	6,719	2,831	852	6,994	41,069	217,389
1928	2,603	9,956	7,015	5,661	231,811	7,359	2,774	1,052	6,462	38,596	257,320
1929	3,377	11,820	6,743	5,574	292,534	7,775	2,358	981	6,319	42,813	296,876
1930	3,647	12,803	6,486	5,071	227,329	7,389	1,656	994	5,736	41,638	290,457
1931	3,363	11,892	5,327	4,472	188,830	6,456	1,545	840	5,039	37,018	332,437
1932	3,508	12,412	4,644	3,876	178,128	6,287	1,136	806	4,673	34,848	312,478
1933	3,181	12,624	4,235	3,815	172,010	4,608	919	737	4,244	41,976	402,609
1934	3,804	14,478	4,234	4,095	174,305	4,860	1,139	838	4,479	46,482	381,516
1935	4,236	15,810	4,082	3,902	207,832	5,258	1,560	777	4,322	54,843	392,666
Total	[7] 93,494	[7] 908,648	571,358	392,370	4,418,800	[3] 139,414	32,199	121,760	421,064	[6] 804,949	4,189,491
Percent of total	0.5	5.2	3.2	2.2	25.1	0.8	0.2	0.7	2.4	4.6	23.8

[1] Includes Alaska 1912-33; Arkansas 1920; Michigan 1900-19; Mississippi 1933-35; Missouri 1889-1911, 1913-16, 1919-23, 1932-35; New Mexico 1913, 1919-23; Tennessee 1916-35; Utah 1907-11, 1920, 1924-35.
[2] New York included with Pennsylvania.
[3] Includes Tennessee 1883-1907.
[4] Less than 500 barrels. (See Mineral Resources, 1916, pt. 2, pp. 684-685.)

States, 1859–1935, by States

of 42 gallons]

Oklahoma	Wyoming	Michigan	Louisiana	New Mexico	Montana	Arkansas	Other [1]	Total: Quantity	Total: Value at wells: Total (thousands of dollars)	Total: Value at wells: Average per barrel	Year
------	------	------	------	------	------	------	----	74,072	215,781	$2.91	1859–75.
------	------	------	------	------	------	------	----	9,133	22,983	2.52	1876.
------	------	------	------	------	------	------	----	13,350	31,789	2.38	1877.
------	------	------	------	------	------	------	----	15,397	18,045	1.17	1878.
------	------	------	------	------	------	------	----	19,914	17,211	.86	1879.
------	------	------	------	------	------	------	----	26,286	24,601	.94	1880.
------	------	------	------	------	------	------	----	27,661	25,448	.92	1881.
------	------	------	------	------	------	------	----	30,350	23,631	.78	1882.
------	------	------	------	------	------	------	----	23,450	25,790	1.10	1883.
------	------	------	------	------	------	------	----	24,218	20,596	.85	1884.
------	------	------	------	------	------	------	----	21,859	19,198	.88	1885.
------	------	------	------	------	------	------	----	28,065	19,996	.71	1886.
------	------	------	------	------	------	------	----	28,283	18,877	.67	1887.
------	------	------	------	------	------	------	----	27,612	17,948	.65	1888.
------	------	------	------	------	------	------	(4)	35,164	26,963	.77	1889.
------	------	------	------	------	------	------	(4)	45,824	35,365	.77	1890.
(4)	------	------	------	------	------	------	(4)	54,293	30,527	.56	1891.
(4)	------	------	------	------	------	------	(4)	50,515	25,907	.51	1892.
(4)	------	------	------	------	------	------	(4)	48,431	28,950	.60	1893.
(4)	2	------	------	------	------	------	(4)	49,344	35,522	.72	1894.
(4)	4	------	------	------	------	------	(4)	52,892	57,632	1.09	1895.
(4)	3	------	------	------	------	------	(4)	60,960	58,519	.96	1896.
1	4	------	------	------	------	------	(4)	60,476	40,874	.68	1897.
------	6	------	------	------	------	------	(4)	55,364	44,193	.80	1898.
------	6	------	------	------	------	------	(4)	57,071	64,604	1.13	1899.
6	6	(5)	------	------	------	------	2	63,621	75,989	1.19	1900.
10	5	(5)	------	------	------	------	2	69,389	66,417	.96	1901.
37	6	(5)	549	------	------	------	1	88,767	71,179	.80	1902.
139	9	(5)	918	------	------	------	3	100,461	94,694	.94	1903.
1,367	12	(5)	2,959	------	------	------	3	117,081	101,175	.86	1904.
(6)	8	(5)	8,910	------	------	------	3	134,717	84,157	.62	1905.
(6)	7	(5)	9,077	------	------	------	3	126,494	92,445	.73	1906.
43,524	9	(5)	5,000	------	------	------	4	166,095	120,107	.72	1907.
45,799	18	(5)	5,789	------	------	------	15	178,527	129,079	.72	1908.
47,859	20	(5)	3,060	------	------	------	6	183,171	128,329	.70	1909.
52,029	115	(5)	6,841	------	------	------	4	209,557	127,900	.61	1910.
56,069	187	(5)	10,721	------	------	------	8	220,449	134,045	.61	1911.
51,427	1,572	(5)	9,263	------	------	------	4	222,935	164,213	.74	1912.
63,579	2,407	(5)	12,499	(5)	------	------	11	248,446	237,121	.95	1913.
73,632	3,560	(5)	14,309	------	------	------	8	265,763	214,125	.81	1914.
97,915	4,246	(5)	18,192	------	------	------	14	281,104	179,463	.64	1915.
107,072	6,234	(5)	15,248	------	45	------	9	300,767	330,900	1.10	1916.
107,508	8,978	(5)	11,392	------	100	------	22	335,316	522,635	1.56	1917.
103,347	12,596	(5)	16,043	------	69	------	16	355,928	703,944	1.98	1918.
86,911	13,172	(5)	17,188	(5)	90	------	27	378,367	760,266	2.01	1919.
106,206	16,831	------	35,714	(5)	340	(5)	27	442,929	1,360,745	3.07	1920.
114,634	19,333	------	27,103	(5)	1,509	10,473	24	472,183	814,745	1.73	1921.
149,571	26,715	------	35,376	(5)	2,449	12,712	23	557,531	895,111	1.61	1922.
160,929	44,785	------	24,919	(5)	2,782	36,610	26	732,407	978,430	1.34	1923.
173,538	39,498	------	21,124	98	2,815	46,028	23	713,940	1,022,683	1.43	1924.
176,768	29,173	4	20,272	1,060	4,091	77,398	36	763,743	1,284,960	1.68	1925.
179,195	25,776	94	23,201	1,666	7,727	58,332	51	770,874	1,447,760	1.88	1926.
277,775	21,307	439	22,818	1,226	5,058	40,005	67	901,129	1,172,830	1.30	1927.
249,857	21,461	594	21,847	943	4,015	32,096	52	901,474	1,054,880	1.17	1928.
255,004	19,314	4,528	20,554	1,830	3,980	24,917	26	1,007,323	1,280,417	1.27	1929.
216,486	17,868	3,911	23,272	10,189	3,349	19,702	28	898,011	1,070,200	1.19	1930.
180,574	14,834	3,789	21,804	15,227	2,830	14,791	13	851,081	550,630	.65	1931.
153,244	13,418	6,910	21,807	12,455	2,457	12,051	21	785,159	680,460	.87	1932.
182,251	11,227	7,942	25,168	14,116	2,273	11,686	35	905,656	608,000	.67	1933.
180,107	12,556	10,603	32,869	16,864	3,603	11,182	51	908,065	904,825	1.00	1934.
185,288	13,755	15,776	50,330	20,483	4,603	11,008	65	996,596	961,440	.96	1935.
[6] 3,879,658	401,043	[8] 54,590	596,136	[9] 96,157	54,185	418,991	733	17,595,040	21,377,249	1.21	Total.
22.0	2.3	0.3	3.4	0.6	0.3	2.4	----	100.0	----------	-----	Percent of total.

[5] Included under "Other."
[6] Oklahoma included with Kansas in 1905 and 1906.
[7] Early production in New York included with Pennsylvania.
[8] Figures represent 1925–35 production only. Earlier years included under "Other."
[9] Figures represent 1924–35 production only. Earlier years included under "Other."

Arkansas.—Arkansas was one of the few States in which drilling declined in 1936; only 24 oil wells were brought in in 1936 compared with 40 in 1935. The downward trend in production, which began in 1925, continued in 1936. The output for the year was 10,419,000 barrels compared with 11,008,000 barrels in 1935.

Exploratory results were generally negative, discoveries being limited to one small, shallow field called Troy in Nevada County; a small, fairly deep field (4,200 feet) in Miller County; and a deep discovery at Snow Hill, Ouachita County, in what is generally called the Permian lime. The Snow Hill discovery looked promising when first found, but producers subsequent to the discovery proved both small and erratic.

Production of crude petroleum in Arkansas, 1926–35, by districts

[Thousands of barrels of 42 gallons]

Year	Bradley	Champagnolle	El Dorado	Irma	Lisbon	Miller	Mount Holly	Smackover	Stephens	Urbana	Total
1926	52		2,722	763	2,125			52,063	607		58,332
1927	44	(1)	[1] 2,433	774	1,054			35,201	499		40,005
1928	31	3,522	2,456	536	566			24,569	416		32,096
1929	24	2,651	1,987	409	492		(2)	[2] 18,991	363		24,917
1930	19	1,486	1,424	380	399		34	15,405	319	236	19,702
1931	5	944	1,186	266	288		4	11,504	272	322	14,791
1932		623	1,182	234	143			9,510	213	146	12,051
1933		488	1,231	264	95	100		8,882	127	499	11,686
1934		486	991	300	89	364		7,916	210	826	11,182
1935		872	862	391	66	444		7,368	212	793	11,008

[1] Champagnolle included with El Dorado. [2] Mount Holly included with Smackover.

California.—Voluntary proration, which broke down in California in the summer of 1935, was restored early in 1936; nevertheless, the State output rose from 207,832,000 barrels in 1935 to 214,773,000 in 1936. Under the curtailment program for 1936, a uniform allowable of 540,000 barrels daily was established in February. This was approximately the actual demand at that time, but increases in demand, seasonal and otherwise, were such as to permit an actual production well over the allowable, plus a substantial withdrawal from stocks.

Although the number of oil wells brought in increased from 729 in 1935 to 792 in 1936, the total initial declined from 660,980 barrels to 374,002 barrels. This decrease reflected principally the declines in pressure in the Kettleman Hills and Mountain View fields.

No sensational gains in output were made in any of the fields in 1936. Kettleman Hills, Ventura Avenue, and Dominguez gained materially, Santa Fe Springs more than held its own, but Long Beach declined.

New discoveries were more in evidence in 1936 than for several years. Five new fields were discovered—Greeley in Kern County, Padre-Canyon in Ventura County, Santa Maria Extension in Santa Barbara County, Ten Section in Kern County, and Wilmington in Los Angeles County. Of these, the first two appeared the most promising as the year closed. Both were seismograph discoveries, indicating the increasing reliance being placed in geophysics in maintaining reserves.

Production of crude petroleum in California, 1932–36, by districts

[Thousands of barrels of 42 gallons]

District	1932 [1]	1933 [2]	1934 [2]	1935 [1]	1936 [1]
San Joaquin Valley:					
Belridge	(3)	2,861	2,916	3,629	4,648
Coalinga	3,650	4,349	6,525	7,249	6,067
Edison			(4)	979	2,023
Elk Hills	4,537	4,478	3,338	3,216	3,194
Fruitvale	1,601	1,656	1,313	1,848	2,903
Kern	3,387	3,162	3,624	4,518	5,163
Kettleman Hills	21,960	21,639	21,391	27,607	29,287
Lost Hills	[3] 3,330	339	1,442	1,762	1,347
McKittrick	652	621	1,076	1,394	777
Midway-Sunset	17,929	17,512	19,651	20,240	21,482
Mount Poso	2,908	2,980	3,348	5,540	6,747
Mountain View		228	2,581	9,229	9,713
Round Mountain		186	1,151	2,327	3,955
Other	1,116	1,103	1,005	153	321
Total San Joaquin Valley	61,070	61,114	69,361	89,691	97,627
Coastal District:					
Capitan	3	29	194	522	571
Elwood	5,442	4,914	4,100	4,560	4,479
Rincon	628	679	538	670	754
Santa Barbara	156	233	559	1,144	504
Santa Maria	1,081	1,233	1,749	1,531	1,668
Santa Miguelito	252	390	268	296	580
Ventura Avenue	12,333	12,561	9,865	10,979	12,610
Other	1,322	1,231	1,449	1,509	1,735
Total Coastal	21,217	21,270	18,722	21,211	22,901
Los Angeles Basin:					
Brea Olinda	3,018	2,938	3,720	3,612	2,961
Coyote	3,716	3,684	4,112	4,540	3,944
Dominguez	6,824	6,628	6,650	7,916	9,712
Huntington Beach	8,016	12,974	15,006	15,133	13,247
Inglewood	4,869	4,055	3,364	4,477	4,547
Long Beach	27,436	24,395	22,788	26,563	24,994
Montebello	2,163	1,931	1,963	2,287	3,205
Playa del Rey	5,911	4,004	3,116	5,696	4,644
Richfield	2,264	2,416	2,856	2,804	2,443
Rosecrans	1,126	1,069	1,032	993	804
Santa Fe Springs	22,538	18,229	14,662	16,159	16,460
Seal Beach	4,522	3,143	2,715	3,381	3,463
Torrance	2,281	2,331	2,498	2,498	2,860
Other	1,157	1,829	1,740	871	961
Total Los Angeles Basin	95,841	89,626	86,222	96,930	94,245
Total California	178,128	172,010	174,305	207,832	214,773

[1] American Petroleum Institute.
[2] Central Committee of California Oil Producers.
[3] Lost Hills includes Belridge.
[4] Included under "Other."

Colorado.—The production record for Colorado in 1936 was similar to that in 1935, in that the total for the State increased, largely because of a gain in the Iles field. The total output rose from 1,560,000 barrels in 1935 to 1,674,000 in 1936. Of the total, Iles accounted for about 70 percent.

What has been characterized as the most important discovery in Colorado since Moffat in 1923 was the finding of oil in the Tertiary (Eocene) on the Powder Wash structure in the northwestern corner of the State. This was the first Tertiary oil found in the Rocky Mountain district. The Gramps field in Archuleta County, discovered in 1935, was considerably extended, but market conditions prevented commercial production.

Production of crude petroleum in Colorado, 1926–35, by districts

[Thousands of barrels of 42 gallons]

Year	Boulder	Florence	Fort Collins [1]	Greasewood	Iles	Moffat	Rangely	Tow Creek	Total
1926	2	148	1,222	--------	24	1,199	33	140	2,768
1927	(2)	[3] 291	1,260	--------	263	670	[4] 69	278	2,831
1928	(2)	[3] 430	1,030	--------	626	464	[4] 34	190	2,774
1929	(2)	[3] 344	824	--------	546	436	[5] 35	173	2,358
1930	(2)	[3] 200	485	(2)	382	394	[6] 47	148	1,656
1931	(2)	[3] 135	355	173	391	321	[5] 49	121	1,545
1932	(2)	[3] 111	290	108	245	248	[5] 33	101	1,136
1933	(2)	[3] 91	226	56	213	212	[5] 33	88	919
1934	(1)	[3] 83	186	37	529	173	[6] 60	71	1,139
1935	(2)	[3] 72	145	22	1,067	150	[6] 36	68	1,560

[1] Includes Wellington.
[2] Included with Rangely.
[3] Includes Canon City.
[4] Includes Boulder and Walden.
[5] Includes Berthoud, Boulder, and Walden.
[6] Includes Berthoud, Boulder, Greasewood, and Walden.

Illinois.—Illinois figured more prominently in the oil industry in 1936 than at any time since it was the third ranking producer, about 30 years ago. The greater interest resulted principally from the active leasing campaign of the major companies in the southern half of the State, secondarily from increased activity in drilling and the use of secondary-recovery methods in the older fields. One new field, Bartelso, was discovered. The production rose from 4,322,000 barrels in 1935 to 4,445,000 in 1936, the increase nearly compensating for the decline in 1935.

Indiana.—Although most of the drilling in Indiana in 1936 was for gas, the number of oil wells brought in rose from 37 in 1935 to 45 in 1936. Production, which had declined in 1935, rose from 777,000 barrels to 798,000 in 1936.

Kansas.—Production in Kansas reached a new high in 1936 with a total output of 58,329,000 barrels, an increase of about 3,500,000 barrels in comparison with the 1935 total. Field work also increased, and 1,214 oil wells were completed in 1936 compared with 890 in 1935. Although the ratio of dry holes continued to be above the national average, the percentage of failures in wildcat operations was remarkably low, and numerous discoveries were made. The number of new fields found in 1936 may be placed anywhere between about 35 and 70, depending on how they are eventually connected with older areas. The exploratory work extended over most of the State, even in the old stripper area in eastern Kansas, but most of the new discoveries were in Ellis, Rice, and Russell Counties. Of considerable geological interest was the discovery of flush production in the Viola lime in Reno County.

The Burrton pool continued to lead in production in 1936, with substantial gains in the prolific Silica pool of Rice and Barton Counties and in the Oxford pool of Sumner County.

Production of crude petroleum in Kansas in 1936, by districts and months [1]

[Thousands of barrels of 42 gallons]

District	Jan.	Feb	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1936	1935
Butler:														
Eldorado	306	268	305	294	306	296	298	296	284	286	281	288	3,508	3,920
Other	218	201	230	217	208	206	237	239	222	233	218	227	2,656	2,792
Ellis	15	16	29	47	43	38	68	91	89	98	100	124	758	167
Ellsworth:														
Lorraine	221	238	247	240	222	197	203	206	182	185	176	162	2,479	1,704
Other	49	47	49	46	47	39	46	47	43	44	40	38	535	892
Greenwood	313	275	335	328	345	332	363	353	340	349	327	341	4,001	4,089
Harvey:														
Hollow-Nikkel	146	125	139	137	127	115	119	124	112	114	111	111	1,480	2,845
Other	2	3	4	4	6	5	4	11	13	16	19	25	112	71
McPherson:														
Graber	10	8	11	15	24	16	42	57	55	61	62	81	442	191
Ritz-Canton	227	186	215	204	203	185	203	196	182	178	172	195	2,346	2,974
Voshell	105	94	102	98	98	85	90	93	87	85	82	85	1,104	1,670
Other	54	45	52	51	52	45	49	52	46	43	38	45	572	750
Reno:														
Burrton	398	362	429	467	459	354	447	528	482	459	425	438	5,248	7,439
Other	34	32	41	52	55	50	69	77	78	82	76	91	737	145
Rice:														
Chase	310	278	318	302	292	293	294	309	276	274	264	279	3,489	4,934
Hauschild	-----	-----	-----	-----	-----	39	34	54	59	60	65	85	396	-----
Raymond	76	76	98	102	117	104	96	105	93	88	86	91	1,132	1,013
Silica	147	150	209	286	326	307	359	421	401	365	364	451	3,786	(2)
Other	151	127	164	191	204	211	234	263	261	268	254	296	2,624	2,122
Russell:														
Fairport	88	73	85	84	84	78	81	71	71	71	69	72	927	1,025
Gorham-East Gorham	110	121	142	138	126	117	140	156	159	167	184	202	1,762	1,040
Russell-West Russell	79	102	107	103	70	65	88	92	83	99	103	99	1,090	1,090
Sullivan	51	65	88	95	110	76	77	86	71	80	83	110	992	(2)
Trapp-North Trapp	-----	-----	-----	-----	-----	-----	28	40	58	83	89	96	394	-----
Other	96	109	159	187	182	176	159	175	160	176	164	166	1,909	991
Sedgwick	208	187	198	222	188	169	147	144	138	139	111	151	2,002	2,973
Sumner:														
Oxford	297	254	256	216	165	138	132	121	108	94	82	98	1,981	1,024
Wellington	40	36	42	53	51	38	55	64	69	71	78	80	677	144
Other	57	44	50	46	45	44	46	50	50	50	44	47	573	909
Other	536	480	571	610	600	604	631	640	645	678	649	728	7,372	6,450
Total	4,344	4,002	4,675	4,835	4,755	4,442	4,839	5,161	4,917	4,996	4,816	5,302	57,084	53,364

[1] Oil & Gas Journal.
[2] Included in "Other."

Kentucky.—Production continued to increase in Kentucky in 1936, following a material gain in drilling. Most of the successful completions were in the new Livermore pool of McLean County, which yielded nearly a million barrels in 1936 compared with a few thousand barrels in 1935. This gain offset natural declines in the older pools, and the State total rose to 5,628,000 barrels from 5,258,000 in 1935. Although field work continued to center in the western counties, the old eastern area was the scene of considerable repressuring.

Louisiana.—As already indicated, Louisiana followed her substantial increase in output in 1935 with an even larger gain in 1936. Most of the increase in 1936 was made at Rodessa, but the coastal area continued its rapid rise in importance.

Activities in the Rodessa field overshadowed all other developments in northern Louisiana in 1936. The number of oil wells completed in the field rose from 31 in 1935 to 285 in 1936 and the production from 1,353,000 barrels in 1935 to 19,039,000 in 1936. The output in the older fields was generally lower in 1936 than in 1935, even though several important finds were made at Sligo and other places in the Glen Rose and the deeper Travis Peak formations.

Production from the coastal district of Louisiana established a new record in 1936, the total of 52,877,000 barrels being nearly 30 percent higher than the previous record of 1935. Most of the fields increased their production over 1935, the gains in the Caillou Island, New Iberia, Black Bayou, and Sulphur fields being notable. Production at Iowa declined, but the field was the leading producer in the district in 1936, as in 1933, 1934, and 1935.

Development in the coastal fields in 1936 was characterized by deep drilling, a number of 10,000-foot wells being completed. The exploratory work resulted in the discovery of five new fields—Charenton, Cankton, Valentine, South Jennings, and Bayou Mallet—and extensions or new sands in at least a dozen of the older pools.

Production of crude petroleum in Louisiana, 1926–35, by districts

[Thousands of barrels of 42 gallons]

District	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
Gulf coast:										
Anse la Butte	17	17	16	14	9	12	11	(1)	(1)	(1)
Bayou Bouillon			205	72	78	15				
Black Bayou				(1)	177	477	353	292	422	564
Bosco									1,036	6,355
Caillou Island								362	1,748	3,288
Cameron Meadows						(1)	(1)	(1)	419	1,046
Choctaw						104	146	100	324	276
Darrow									(1)	263
Edgerly	207	467	358	245	161	109	63	50	65	80
English Bayou										713
Gillis									(1)	1,492
Gueydan							195	165	110	82
Hackberry		42	1,149	1,783	1,213	1,399	2,149	1,938	1,911	2,580
Iowa							489	3,396	5,300	7,363
Jennings	342	299	250	515	495	169	332	400	444	686
Lafitte										635
Lake Barre				46	388	1,021	2,722	3,021	1,894	2,792
Lake Washington						39	152	154	368	500
Leesville						154	273	359	4,487	[2] 5,388
Lockport	1,343	2,038	1,445	1,369	1,131	1,906	989	938	714	655
Port Barre				33	970	450	577	956	937	1,250
Roanoke									241	1,631
Sorrento			289	110	30	53	13	15	(1)	(1)
Starks		262	186	170	206	260	289	328	262	195
Sulphur		(1)	890	1,374	1,362	567	822	910	1,256	944
Sweet Lake	(1)	77	661	93	193	459	271	335	385	403
Vinton	2,215	1,786	1,569	1,484	1,768	1,940	1,514	1,302	1,168	906
White Castle				(1)	300	329	200	192	191	196
Other	16	62	35	146	129	97	56	93	112	493
Total Gulf coast	4,140	5,050	7,053	7,454	8,610	9,560	11,616	15,306	23,794	40,776
Northern:										
Bellevue	788	472	323	255	233	93			85	202
Caddo	4,749	5,789	4,798	[3] 4,589	4,120	3,054	2,486	2,248	2,200	2,630
Converse									[4] 665	[4] 521
Cotton Valley	2,914	1,968	1,731	1,040	880	509	353	307	290	233
De Soto	321	541	463	276	247	192	469	411	398	379
Elm Grove	222	222	185	178	172	149	109	107	116	95
Haynesville	3,328	2,600	2,150	1,806	1.743	1,902	1,534	1,402	1,379	1,266
Holly					308	189	99	74	65	56
Homer	2,033	1,785	1,548	1,405	1,278	1,083	1,021	991	980	977
Pleasant Hill				(5)	178	115	85	(6)	(4)	(4)
Red River (Bull Bayou, Crichton)	1,037	1,070	1,109	987	838	713	257	190	145	143
Rodessa										1,364
Sarepta				(3)	[7] 888	[7] 259	[7] 119	[6] 242	(4)	(4)
Urania	3,669	3,321	2,487	2,155	1,976	1,448	1,208	883	1,077	1,062
Zwolle				[5] 409	1,801	2,538	2,451	3,007	1,675	626
Total northern	19,061	17,768	14,794	13,100	14,662	12,244	10,191	9,862	9,075	9,554
Total Louisiana	23,201	22,818	21,847	20,554	23,272	21,804	21,807	25,168	32.869	50,330

[1] Included under "Other".
[2] Includes Little Bayou.
[3] Caddo includes Carterville and Sarepta.
[4] Converse includes Pleasant Hill and Sarepta.
[5] Zwolle includes Pleasant Hill.
[6] Sarepta includes Carterville and Pleasant Hill.
[7] Includes Carterville.

Michigan.—Production in Michigan in 1936 suffered its first setback in 5 years, the total output for the year being 11,828,000 barrels, or nearly 4,000,000 barrels less than in 1935. This decrease resulted mainly from rapid declines in the Porter and Crystal fields. Furthermore, the total initial of the 338 oil wells completed in 1936 was hardly more than a third of the total initial of the 322 oil wells completed in 1935.

Wild-catting was fairly successful, and several new fields and extensions were found. Of these, the Buckeye field of Gladwin County seemed the most promising; in fact, by February 1937 it was the chief factor in reversing the trend in the State output, which had been generally downward throughout 1936.

Production of crude petroleum in Michigan, 1926–35, by districts

[Thousands of barrels of 42 gallons]

Year	Crystal	Mount Pleasant	Muskegon	Porter	Saginaw	Vernon	West Branch	Yost-Jasper	Other	Total
1926	-------	-------	-------	-------	94	-------	-------	-------	-------	94
1927	-------	-------	(1)	-------	[1] 439	-------	-------	-------	-------	439
1928	-------	(2)	338	-------	[2] 256	-------	-------	-------	-------	594
1929	-------	1,394	3,019	-------	115	-------	-------	-------	-------	4,528
1930	-------	2,599	1,223	-------	89	-------	-------	-------	-------	3,911
1931	-------	2,608	577	-------	59	[3] 244	-------	-------	301	3,789
1932	-------	[3] 5,796	[3] 479	-------	[3] 64	[3] 322	-------	19	230	6,910
1933 [3]	-------	3,129	276	3,354	55	539	-------	219	370	7,942
1934 [3]	-------	1,513	159	7,168	48	907	-------	276	532	10,603
1935 [3]	3 605	1,130	102	8,317	27	633	524	875	563	15,776

[1] Muskegon included with Saginaw.
[2] Mount Pleasant included with Saginaw.
[3] Department of Conservation, Michigan.

Mississippi.—No commercial production is credited to Mississippi in 1936, as the several oil wells on the edge of the Jackson field were reported as shut down. Field work was confined to gas wells, several of which were completed by the State on its own land.

Missouri.—Production in Missouri continued to be restricted to about 25,000 barrels annually, most or all of which was marketed as fuel oil. Drilling in recent years has resulted in about a dozen producers annually; these have had an average initial production of about 5 barrels.

Montana.—Development work was active in Montana in 1936, and 166 oil wells were completed compared with 131 in 1935. Production continued the upward trend that began with the discovery of the Cut Bank field, the output rising to 5,588,000 barrels, compared with 4,603,000 in 1935.

The most interesting development in Montana in 1936 was the discovery of oil in deep zones on the Baker-Glendive structure, although, from the standpoint of production in 1936 and the immediate future, the extensions made in the Cut Bank field were more important. The Mosser dome near Billings was proved for oil and gas in 1936. Acid treatment of wells expanded and was generally successful in 1936; in fact, the increases in production in older fields like Kevin-Sunburst was due almost entirely to this practice.

Production of crude petroleum in Montana, 1926–35, by districts

[Thousands of barrels of 42 gallons]

Year	Border	Cat Creek	Cut Bank	Dry Creek	Elk Basin	Kevin-Sunburst	Lake Basin	Pondera	Other	Total
1926		1,015			19	6,630	63			7,727
1927		[1] 779			17	4,214	48			5,058
1928		[1] 613			20	3,189	43	150		4,015
1929		[1] 497			19	2,378	29	1,057		3,980
1930	120	418		15	16	1,998	23	739	20	3,349
1931	178	359		164	16	1,557	25	525	6	2,830
1932	113	311		195	11	1,337	18	436	36	2,457
1933	51	266	238	125	3	1,237	18	308	27	2,273
1934	70	236	1,204	(2)	16	1,628	16	363	70	3,603
1935	40	311	2,321	(2)	11	1,371	(2)	441	108	4,603

[1] Includes small amounts from Bannatyne and Devils Basin.
[2] Included with "Other."

New Mexico.—A new record for production in New Mexico was established in 1936—27,185,000 barrels, compared with 20,483,000 in 1935—although production at Hobbs, the leading field, continued to decline. The material gain in output is traceable to developments in the Eunice and Monument fields, where most of the drilling was done. Drilling on the edges of the two fields virtually proved them to be parts of a structure probably surpassing in size that at Hobbs. Four fields were discovered during the year; all but one were in Lea County.

Production of crude petroleum in New Mexico, 1926–35, by districts

[Thousands of barrels of 42 gallons]

Year	Artesia	Hobbs	Hogback	Lea	Rattlesnake [1]	Total
1926	1,016		221	[2] 2	427	1,666
1927	582		223	[2] 39	382	1,226
1928	410		169	[2] 69	295	943
1929	323	(3)	120	[4] 899	488	1,830
1930	261	6,525	159	[5] 2,782	462	10,189
1931	426	12,788	176	[5] 1,490	347	15,227
1932	480	10,237	133	[5] 1,345	260	12,455
1933	596	11,543	77	[5] 1,609	291	14,116
1934	898	12,628	76	[5] 2,962	300	16,864
1935	867	11,276	69	[5] 7,970	301	20,483

[1] Includes Bloomfield and Table Mesa in 1926; Hospah and Table Mesa in 1929; Table Mesa in 1930–32; and Aztec and Table Mesa in 1933–35.
[2] Maljamar only.
[3] Included with Lea.
[4] Includes Hobbs, Jal, Maljamar, and other pools in Lea County.
[5] Includes Jal, Maljamar, and other pools in Lea and Eddy Counties.

New York.—The upward trend of production in New York was continued in 1936. The total output for the year was 4,663,000 barrels, compared with 4,236,000 barrels in 1935. The increase resulted from expanded activities under the water-flooding program in response to higher prices.

Ohio.—Production continued to decline in Ohio in 1936 coincidental with the failure to find any new fields of importance and the comparative absence of secondary-recovery projects. The total output in 1936 was 3,847,000 barrels compared with 4,082,000 barrels in 1935. In 1936 oil wells completed totaled 343 and the initial 7,060 barrels; in 1935, 299 oil wells were brought in with a total initial of 4,523 barrels.

Oklahoma.—Production in Oklahoma in 1936 totaled 206,809,000 barrels. This was about 21,500,000 barrels above the output in 1935 and the largest annual total recorded since 1930.

Drilling, which had increased materially in 1935, showed an even larger gain in 1936. There were 1,790 oil wells completed in the State in 1936, or about a third more than in 1935. The large number of dry holes drilled during the year, 649, attests the intensive efforts to find new reserves. The most active area in drilling was Pontotoc County, in which the Fitts pool is located. Other leading counties in field activity were Osage, Seminole, and Oklahoma.

Both Oklahoma City and Seminole, supposedly on the down grade as producers, registered small increases in output in 1936 over 1935. Production at Oklahoma City was sustained largely by the development of the Capitol extension, and at Seminole by drilling inside locations and by reworking old wells. The largest increase in production in any field was at Fitts, which yielded about 20,000,000 barrels in 1936 compared with 7,000,000 in 1935. Other notable gains in output were recorded in the South Burbank, Keokuk Falls, Olympic, and Edmond pools.

Although numerous discoveries were made in Oklahoma in 1936, most of them were extensions laterally or vertically in old fields. Many of the discovery wells had surprisingly large initials but comparatively small drainage areas. Listed as important were the discovery of Wilcox-sand production in the Moore pool, substantial production in the Hunton lime at Fitts, and the extension of the Olympic field. Attempts to find deep Ordovician pools had little success.

Production of crude petroleum in Oklahoma in 1936, by districts and months [1]

[Thousands of barrels of 42 gallons]

District	January	February	March	April	May	June	July	August	September	October	November	December	1936	1935
Allen	209	205	221	237	265	297	320	300	261	248	253	260	3,076	2,897
Bristow-Slick	259	237	267	254	264	254	330	283	254	266	256	262	3,186	3,329
Burbank	229	213	239	231	238	231	244	241	239	248	226	248	2,827	3,102
Crescent	134	152	164	143	162	159	179	202	240	271	224	271	2,301	2,003
Cushing	362	331	361	349	367	354	354	341	322	334	328	326	4,129	4,738
Edmond	210	266	337	377	376	360	336	384	450	425	405	444	4,370	1,478
Fish	326	301	311	297	301	270	249	221	205	207	203	223	3,114	3,422
Fitts	1,086	1,219	1,480	1,502	1,679	1,554	1,509	1,939	1,887	2,010	1,905	2,138	19,908	6,901
Healdton	276	257	286	278	287	277	295	297	288	304	288	303	3,436	3,397
Lincoln	196	192	210	199	235	212	219	214	197	208	195	195	2,472	2,614
Lucien	319	299	387	379	413	402	369	391	389	391	376	427	4,542	3,744
Nowata	191	163	219	232	265	259	371	314	301	301	279	284	3,179	2,414
Okfuskee	113	103	140	142	148	141	112	72	79	78	77	80	1,285	1,281
Oklahoma City	4,196	3,972	4,110	4,329	4,334	4,122	4,117	4,590	4,224	4,415	4,249	4,574	51,232	53,386
Okmulgee	142	130	158	138	145	140	152	152	133	135	131	136	1,692	1,796
Olympic	83	120	150	182	236	241	216	303	232	252	323	373	2,711	(2)
Osage (outside Burbank)	707	676	738	708	739	715	719	683	653	664	641	650	8,293	9,113
Pawnee-Payne Creek	303	286	310	313	321	309	323	313	285	297	292	299	3,651	4,026
Seminole field:														
Bowlegs	271	294	360	442	433	387	350	366	339	368	353	372	4,335	3,845
Carr City	143	162	194	223	213	203	170	210	167	164	182	185	2,216	2,003
Earlsboro and North and South	255	217	259	248	245	245	320	244	210	232	223	217	2,915	3,945
East Earlsboro and West Seminole	298	284	349	331	334	328	326	314	299	284	266	273	3,686	3,469
Little River and East Little River	463	430	444	416	439	447	431	427	399	408	364	400	5,068	5,587
St. Louis-Pearson	660	643	714	762	785	775	685	719	670	733	687	710	8,543	8,365
Seminole City	354	315	329	326	345	345	291	313	294	297	296	305	3,810	4,062
Other	284	265	312	316	376	374	370	382	366	381	347	377	4,150	3,347
Total, Seminole field	2,728	2,610	2,961	3,064	3,170	3,104	2,943	2,975	2,744	2,867	2,718	2,839	34,723	34,623
South Burbank	371	367	448	491	470	472	459	479	455	471	433	474	5,390	4,217
Stephens-Cotton	170	160	177	169	179	171	179	178	177	179	170	176	2,085	2,094
Tulsa	104	101	123	107	115	116	119	99	91	113	108	112	1,308	1,432
Washington	99	83	111	108	109	106	112	102	103	109	105	109	1,256	1,296
Other	2,423	2,332	2,552	2,501	2,554	2,533	2,628	2,656	2,551	2,667	2,558	2,760	30,715	29,294
Total	15,236	14,775	16,460	16,730	17,372	16,799	16,854	17,729	16,760	17,460	16,743	17,963	200,881	182,597

[1] Oil and Gas Journal.
[2] Included under "Other."

Pennsylvania.—Total production in Pennsylvania in 1936 was 17,070,000 barrels, compared with 15,810,000 in 1935. Although most of the increase was recorded in the water-flood areas of the Bradford field, which yield nearly half the State output the other districts (Kane–Butler and Southwest) showed surprisingly large gains in production. This was due primarily to the successful application of secondary methods, although deeper drilling in the Oriskany in Washington County is reported to have been quite fruitful.

Tennessee.—Although production in Tennessee continued to be virtually negligible at 10,000 to 20,000 barrels annually, the higher prices for crude renewed interest in drilling, and several of the old areas were being explored for deeper production at the close of 1936.

Texas.—Production in Texas in 1936 rose to a new record of 427,280,000 barrels—about 9 percent higher than in 1935. As in 1934 and 1935, all the gain was outside of the East Texas field; in fact, all the other major districts gained in 1936.

The State is so large and production so scattered that it is customary to discuss developments in Texas by districts. No two of the half dozen or more agencies dealing in production statistics divide Texas into the same districts. This suggests the possibility of a joint conference in the interests of uniformity; but, pending such action, the Bureau's districts will remain essentially as follows: Pandhandle, including counties north of a line drawn from the southern boundary of Collin County to the southern boundary of Deaf Smith County; West Texas, including all counties south of the Panhandle and west of a line drawn southward between counties from the east boundary of Childress County to the east boundary of Maverick County; North Texas, including counties east of the line just described, west of Fannin, Hunt, and Van Zandt Counties, and north of a line drawn from the south boundary of Runnels County to the south boundary of Kaufman County; East Texas, for which the inside border counties are Fannin, Hunt, Van Zandt, Henderson, Anderson, Houston, Trinity, Polk, Tyler, Jasper, and Newton; South Texas, including Dimmit, LaSalle, McMullen, Live Oak, Webb, Duval, Jim Wells, Zapata, Jim Hogg, Brooks, Starr, and Hidalgo Counties; and Central and Gulf districts, separated by a line dividing Bee and San Patricio Counties on the southwest, Colorado from Wharton and San Jacinto from Liberty, with Montgomery included in the Gulf. The only change made in these districts in the past year was the transfer of Zavalla and Frio Counties from the South (formerly Southwest) Texas district to Central Texas.

Although production in the Panhandle increased slightly in 1936, the district passed a relatively quiet year. No new oil fields were discovered; and, except for one dry hole carried beyond 8,000 feet, wildcatting was at a low ebb. The production for the year was 22,471,000 barrels compared with 21,369,000 in 1935. The number of oil wells completed declined from 585 in 1935 to 466 in 1936.

Production in the west Texas district continued to increase parallel with the growth in general interest in the area. Production increased from 55,417,000 barrels in 1935 to 61,901,000 in 1936, while the number of oil wells completed more than doubled, rising from 653 in 1935 to 1,369 in 1936.

Production at Yates (the leading field of the district) declined, but material gains were made in Ward County and in the Cowden, Sayre and Goldsmith fields. The latter, particularly, proved to be large.

About six or eight new fields were discovered in the west Texas district in 1936, and several new counties produced for the first time. The district was enlarged considerably, particularly on the north, although extensions in the older fields probably had more influence on production. Among the new discoveries, the following seemed to be the most important: Bennett, Yoakum County; Henderson, Wilkler County; and Seminole, Gaines County.

Apparently both production and drilling in the north Texas district were stimulated by higher prices and showed small gains over 1935. New discoveries were few, as the area has been explored carefully for surface indications and as considerable territory has been condemned by tests to the granite. Most of the fields suffered a natural decline in output, increases in Jones, Cooke, and Jack Counties being outstanding. The most important discoveries for 1936 appeared to be a pool near Bryson, Jack County, and the Anderson-Kerr (Bruhlmeyer) pool near Gainesville in Cooke County.

Production and bottom-hole pressures in the east Texas field proper continued to decline in 1936, but neither caused great concern, as the output is still severely prorated and as bottom-hole pressures generally decrease as the oil is withdrawn. The output for the year was 168,046,000 barrels from producing wells ranging in number from 19,520 on January 1 to nearly 22,000 at the close of 1936. Bottom-hole pressure at the end of the year was 1,168 pounds, or only 25 pounds below the pressure on January 1. Drilling in the east Texas field in 1936 was virtually confined to inside locations, the number of oil wells brought in declining from 4,033 in 1935 to 2,335 in 1936. The average size of the new completions continued to decline, the average in 1936 being 1,150 barrels daily initial compared with an average of 1,590 barrels in 1935.

Although completely overshadowed by the east Texas field, the Van field continued in the select circle of pools that produce more than 10,000,000 barrels annually. Its output fell from about 14,000,000 barrels in 1935 to about 13,000,000 in 1936, but the decline was due entirely to reduced allowables.

The Rodessa field was known to extend into Texas in 1935, but development did not get under way until 1936. Production from about 160 wells in 1936 was 3,091,000 barrels, compared with only 12,000 barrels in 1935. Apparently most of the field will be in Texas eventually.

Another active field was Cayuga, where about 60 oil wells were completed in 1936. A second deep test to the Trinity was drilled at Cayuga in 1936—it was a distillate producer at 7,570 feet.

The district remained a popular section for wildcatting, and with reason, as several important discoveries were made. Most important of these were the Talco field of Titus and Franklin Counties and the Sulphur Bluff field of Hopkins County. These are fault-line pools in the Lower Cretaceous. Several other discoveries were made, but they were distillate producers.

The number of oil wells completed in the South Texas district, formerly called Southwest Texas, in 1936 was about 1,400, or double the number completed in 1935. Most of the drilling was confined to inside locations in the Loma Novio, Lopez, and Seven Sisters fields. Increased production in those fields outweighed declines in the older fields, and the total output of the district accordingly rose from about 13,000,000 barrels in 1935 to about 19,000,000 in 1936.

Wildcatting was not quite as extensive or as successful in 1936 as in 1935, the half dozen or more new productive spots appearing to be of little importance as the year closed.

Comparisons for the Central Texas district are hard to draw, as no two sets of data cover exactly the same fields; however, apparently the "fault-line" or Edwards lime area passed another relatively quiet year in 1936, with production virtually unchanged and with few discoveries. The only new fields brought in were Zoboroski in Guadalupe County and Pearsall in Frio County.

The success that has attended exploratory work in the Texas Gulf Coast district in recent years was evidenced in production, which continued to establish new records in almost every month of 1936. The total output for 1936 was 86,283,000 barrels, compared with 64,914,000 in 1935.

Conroe, the leading producing field of the district, again dropped in output, undoubtedly reflecting adjustments in allowables rather than inability to produce to the 1935 level. Important gains in production were scored in the Saxet, Greta, Anahuac, and Plymouth fields.

Approximately 25 new discoveries were made in the district in 1936, most, perhaps all, as the result of geophysical prospecting. Among the new fields with the most promise were Amelia, Jefferson County; Flour Bluff, Nueces County; and Heyser, Calhoun County.

Production of crude petroleum in Texas, 1926–35, by districts

[Thousands of barrels of 42 gallons]

District	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
Gulf coast:										
Agua Dulce								(1)	107	(1)
Anahuac										358
Arriola								(1)	446	404
Barbers Hill	(2)	(2)	(2)	4,552	7,441	7,651	7,320	8,082	6,820	6,765
Batson	456	462	550	444	418	330	268	208	246	588
Big Creek	520	1,243	811	1,496	1,390	858	425	413	365	362
Blue Ridge	486	1,210	2,205	1,194	644	378	328	295	299	335
Boling	1,175	753	814	580	378	269	188	126	209	182
Buckeye							105	272	75	72
Clay Creek						553	356	334	266	361
Cleveland								(1)	172	228
Conroe							2,630	21,215	17,761	15,276
Damon Mound	341	312	291	224	224	282	219	(3)	113	193
Dayton	(1)	(1)	(1)	214	406	202	100	55	74	62
Dickinson									(1)	280
Esperson				(1)	819	712	509	481	452	395
Fannette			(1)	292	350	180	151	146	195	237
Goose Creek	[2] 3,501	[2] 3,102	[2] 2,726	2,154	1,690	1,460	1,232	1,163	1,203	1,069
Greta								1,195	3,936	4,769
Hankamer				(1)	546	798	691	547	378	565
Hastings										689
High Island	60	96	163	449	331	255	1,547	2,534	2,747	2,513
Hull	7,058	5,685	4,055	3,376	3,128	2,264	1,891	1,946	3,453	2,311
Humble	1,568	1,485	1,242	2,990	5,859	3,022	2,144	1,722	1,188	1,230
Keeran								96	118	108
Kingsville		146	153	120	41	29	28	26	23	21
Livingston								435	744	1,057
Lost Lake				99	209	96	127	84	67	84
Louise									178	409
Manvel							160	586	1,020	2,467
Markham	51	109	112	133	98	218	516	351	389	459
Moss Bluff					(1)	154	38	(1)		
Mykawa							(1)	70	133	705
Nash	207	395	491	193	110	187	55	(3)	16	13
O'Connor								(1)	112	511
Orange	3,458	1,803	1,415	1,006	790	618	451	312	289	263
Orchard	75	22	44	44	636	495	496	413	457	238
Pierce Junction	948	2,954	3,899	5,160	3,847	2,831	1,763	1,524	1,196	1,093
Port Lavaca										149

See footnotes at end of table.

Production of crude petroleum in Texas, 1926–35, by districts—Continued

[Thousands of barrels of 42 gallons]

District	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
Gulf coast—Continued.										
Port Neches	------	------	------	242	672	503	553	383	557	593
Raccoon Bend	------	1	98	2,084	3,893	2,704	1,814	1,544	1,489	1,681
Refugio	------	------	(1)	1,990	11,485	9,274	3,424	2,105	1,489	1,641
San Patricio	------	------	------	------	------	------	------	------	(1)	1,061
Saratoga	482	413	343	333	380	360	326	302	291	315
Saxet	------	------	------	------	(1)	152	486	861	775	1,336
Sourlake	2,004	1,593	1,185	946	806	675	570	453	484	602
South Liberty	1,992	1,084	1,398	2,137	1,503	694	369	255	155	190
Spindletop	13,441	20,751	14,150	10,037	6,176	3,301	1,387	1,149	1,052	962
Sugarland	------	------	390	3,948	4,274	4,216	3,487	2,532	2,183	2,098
Thompsons	------	------	------	------	------	808	4,201	4,906	4,245	4,123
Tomball	------	------	------	------	------	------	------	233	990	1,899
West Columbia	3,197	3,291	2,800	2,298	1,827	1,310	1,295	[3] 1,441	1,038	857
Other	115	94	301	917	695	193	200	207	160	735
Total Gulf coast	41,135	47,004	39,636	49,652	61,066	48,032	41,850	61,002	60,155	64,914
East Texas:										
East Texas proper [4]	------	------	------	------	------	109,561	121,449	204,954	181,540	176,859
Boggy Creek	------	15	331	1,120	1,133	618	378	[5] 292	[5] 243	[5] 298
Camp Hill	------	------	------	------	------	------	------	------	------	126
Cayuga	------	------	------	------	------	------	------	------	589	1,333
Van	------	------	------	144	7,330	15,598	17,201	17,077	14,621	14,062
Other	36	(6)	(6)	101	109	69	56	49	38	45
Total east Texas	36	[6] 15	[6] 331	1,365	8,572	125,846	139,084	222,372	197,031	192,723
Central Texas:										
Caesar	------	------	------	------	------	------	------	------	------	289
Darst Creek	------	------	------	243	11,552	8,196	6,084	4,565	3,374	3,298
Hilbig	------	------	------	------	------	------	------	(1)	291	274
Kittrell	------	------	------	------	------	------	------	------	(1)	356
Luling	7,699	6,169	[7] 5,443	4,948	3,692	2,964	2,625	2,368	2,187	2,055
Lytton Springs	1,783	784	846	600	489	378	323	405	557	341
Mexia [8]	20,494	12,417	8,353	5,969	4,621	3,201	2,259	2,064	1,947	1,902
Pettus	------	------	------	------	1,730	2,360	1,715	978	[9] 1,128	[9] 2,684
Rockdale-Chapman	535	508	337	251	1,906	1,305	565	371	368	411
Salt Flat (Bruner)	------	------	(7)	13,286	7,305	4,372	2,944	2,020	1,637	1,495
Somerset-Medina	791	767	738	659	566	576	518	521	527	482
Other	52	[6] 72	[6] 75	47	12	19	17	238	50	216
Total central Texas	31,354	[6] 20,717	[6] 15,792	26,003	31,873	23,371	17,050	13,530	12,066	13,803
North Texas [10]	49,932	54,806	49,459	52,046	44,301	29,811	26,475	26,293	31,558	31,098
Panhandle [11]	25,551	40,253	25,286	30,632	31,777	21,851	18,263	16,673	20,280	21,369
South Texas [12]	4,150	3,056	3,276	3,850	4,138	5,002	6,421	7,395	10,154	13,342
West Texas:										
Andrews	------	------	------	------	------	------	------	(1)	217	628
Big Lake	10,937	8,986	6,753	6,460	7,050	9,444	8,265	6,535	4,476	3,610
Chalk-Roberts [13]	1,372	2,437	5,736	15,633	11,999	10,413	7,264	6,257	6,563	8,163
Crane-Upton	2,204	30,607	25,529	16,852	14,451	8,524	7,444	6,396	6,145	6,384
Crockett County [14]	237	516	796	673	693	550	459	355	310	386
Ector	------	------	------	------	3,168	2,597	1,657	1,944	2,625	3,591
Fisher	------	------	(1)	418	532	270	198	944	1,633	1,954
Hendricks	------	3,641	62,045	50,179	26,404	15,510	10,998	8,263	7,612	7,670
Loving County	------	------	------	------	663	1,237	1,134	949	806	698
Ward County	------	------	------	453	931	1,152	1,761	2,559	3,479	5,883
West Yates [15]	------	------	------	461	1,389	502	299	221	394	432
Yates	(1)	5,329	22,429	41,905	41,338	28,226	23,717	20,723	15,991	15,935
Other	8	22	252	294	112	99	139	198	21	83
Total west Texas	14,758	51,538	123,540	133,328	108,730	78,524	63,335	55,344	50,272	55,417
Total Texas	166,916	217,389	257,320	296,876	290,457	332,437	312,478	402,609	381,516	392,666

1 Included under "Other."
2 Barbers Hill included with Goose Creek.
3 West Columbia includes Damon Mound and Nash.
4 Joiner, Kilgore, Lathrop, and other pools in Cherokee, Gregg, Rusk, Smith, and Upshur Counties.
5 Includes Long Lake.
6 "Other" in east Texas included under "Other" in central Texas.
7 Salt Flat included with Luling.
8 Includes other fields in Falls, Freestone, Limestone, and Navarro Counties.
9 Includes Tuleta.
10 Includes the districts in and between Wilbarger, Wichita, Clay, Montague, and Cooke Counties on the north and Runnels, Coleman, Brown, and Comanche Counties on the south.
11 Carson, Gray, Hutchinson, Moore, Potter, and Wheeler Counties.
12 Includes fields in Duval, Hidalgo, Jim Hogg, Jim Wells, Starr, Webb, and Zapata Counties.
13 Includes Westbrook and other f[illegible]
14 Includes World.
15 Includes Taylor-Link.

Utah.—No developments of importance were recorded in Utah in 1936, and the production remained virtually unchanged from that of 1935 at 12,000 barrels.

West Virginia.—Although field activity increased materially in 1936, most of the work was concerned with outlining new gas reserves, and no new oil pools were found. The number of oil wells completed rose from 115 in 1935 to 142 in 1936, but production declined from 3,902,000 to 3,847,000 barrels.

Wyoming.—Drilling increased materially in Wyoming in 1936, 88 wells being completed compared with 58 in 1935. Production at Salt Creek showed a small decline, but this was more than offset by material gains at Lance Creek and the comparatively new fields of Medicine Bow and Quealy. The State production in 1936 was 14,455,000 barrels—700,000 barrels more than in 1935. The largest factor in this increase was the completion of large wells in the Sundance at Lance Creek; in fact, black-oil production and light-oil production outside of Lance Creek together declined approximately 500,000 barrels. Apparently the most important discovery of the year in Wyoming was the finding of a prolific Tensleep zone at Wertz, an old gas field.

Production of crude petroleum in Wyoming, 1926-35, by districts

[Thousands of barrels of 42 gallons]

Year	Big Muddy	Byron-Greybull-Torchlight	Elk Basin	Frannie	Garland	Grass Creek	Hamilton Dome-Warm Springs	La Barge	Lance Creek	Lander-Dallas-Derby Dome	Lost Soldier [1]	Mule Creek
1926	1,215	(2)	273	------	------	1,025	319	70	540	165	2,059	------
1927	1,072	28	337	------	------	974	313	341	269	246	1,341	188
1928	962	25	360	------	------	871	298	490	217	247	1,442	142
1929	802	26	265	------	------	778	355	805	87	209	1,311	141
1930	711	49	264	(2)	------	729	300	747	60	252	1,271	29
1931	649	3	250	214	------	746	87	466	94	358	1,349	------
1932	610	7	190	161	379	787	308	381	38	375	1,003	2
1933	650	(3)	203	85	[3] 181	274	254	349	41	330	632	(2)
1934	634	(3)	177	615	[3] 364	356	322	488	128	316	605	(2)
1935	570	374	133	114	410	727	470	493	735	334	563	(2)

Year	Notches	Oregon Basin	Osage	Pilot Butte	Poison Spider-South Casper	Rex Lake	Rock Creek	Salt Creek	Teapot	Other	Total
1926	34	------	113	20	[4] 376	53	1,029	18,010	426	49	25,776
1927	24	------	107	17	247	44	982	14,399	314	64	21,307
1928	------	882	133	19	327	18	928	14,023	------	77	21,461
1929	------	1,540	166	18	[5] 446	36	842	11,377	------	110	19,314
1930	------	1,285	385	16	[5] 323	6	770	10,520	11	140	17,868
1931	------	393	419	14	[5] 199	------	682	8,834	------	77	14,834
1932	------	130	394	12	91	------	477	8,006	------	67	13,418
1933	------	252	241	12	167	4	464	7,009	------	79	11,227
1934	------	880	289	8	177	9	540	6,520	------	128	12,556
1935	------	1,638	174	(2)	131	(2)	544	6,257	------	88	13,755

[1] Includes Ferris.
[2] Included under "Other."
[3] Garland includes Byron.
[4] Includes Iron Creek and Simpson Ridge.
[5] Includes Simpson Ridge.

REFINED PRODUCTS [2]

A record for refinery operations was established in 1936. Crude oil run to stills amounted to 1,068,000,000 barrels compared with 988,000,000 for 1929, the next highest year, and with 966,000,000 for 1935. Motor fuel and kerosene production and demand reached new peaks, while the gas oil and fuel oil demand, which has been gaining for several years, increased 12 percent during 1936 to 409,-000,000 barrels, still 40,000,000 barrels short of the 1929 record.

The yield of fuel oil—38.5 percent compared with 37.3 percent for 1935—is the highest since 1930 land indicates the increased demand for the lighter fuel oils for heating purposes; the yield of the latter rose 1.4 percent, while the yield of the heavy fuel oils fell 0.2 percent. Part of this advance was at the expense of kerosene, the yield of which dropped 0.5 percent. Although the yield for motor fuel decreased only 0.1 percent—from 44.2 percent in 1935 to 44.1 percent in 1936—it probably would have increased along with increased cracking in some districts had it not been for the strong demand for heating oil.

Natural gasoline blended amounted to 42 million barrels in 1936 compared with 39 million in 1935; and benzol increased 36 percent, from 1,871,000 barrels in 1935 to 2,537,000 in 1936.

The total refinery output of gasoline in 1936 was 513 million barrels, made up of 231 million barrels of straight-run gasoline, 240 million barrels of cracked gasoline, and 42 million barrels of natural gasoline; the quantity produced by cracking still gaining faster than straight-run production. Kerosene production amounted to 56 million barrels, the same as in 1935. Gas-oil and distillate fuel-oil production increased 26 percent, to 126 million barrels in 1936 from 100 million in 1935; and residual fuel oil increased to 286 million barrels from 260 million in 1935.

Analysis of production and consumption of petroleum products in 1936 [1]

Product	Production	Imports	Exports	Changes in stocks	Domestic demand
Motor fuel:					
Gasoline	470,907		24,828	+5,706	440,373
Natural gasoline	42,041		2,549	+357	39,135
Benzol	2,537		454		2,083
Total motor fuel	515,485		27,831	+6,063	481,591
Kerosene	56,082	1	6,886	−2,282	51,479
Gas oil and distillate fuel oil	125,650	485	19,884	+2,789	103,462
Residual fuel oil	285,688	18,650	14,396	+145	[2] 305,529
Lubricants	30,905	3	8,315	−83	22,676
Wax	1,689	57	668	+2	1,076
Coke	6,891		622	+2	6,267
Asphalt	23,024	119	1,162	−204	22,185
Road oil	7,636			−53	7,689
Still gas	54,441				54,441
Other finished oils	2,199	70	68	−22	2,223
Unfinished gasoline (net)	486			+486	
Other finished oils (net)	[3] 8,769	5,106		−3,663	
Refinery losses	11,305				11,305
Total	1,112,712	24,491	79,832	+3,180	[2] 1,069,923

[1] Preliminary.
[2] Includes net transfers from crude oil in California of 15,732,000 barrels.
[3] Negative quantity; represents net excess of unfinished oils rerun over unfinished oils produced.

[2] By H. A. Breakey, Petroleum Economics Division, U. S. Bureau of Mines.

Comparative analyses of statistics for the major refined products, 1932–

[Thousands of barrels of 42 gallons, except as otherwise indicated]

	1932	1933	1934	1935	1936 [1]
Motor fuel:					
Production	399,712	407,932	423,801	468,021	515,485
Imports	8,205	15	1		
Exports	35,438	29,321	24,686	30,613	27,831
Stocks, end of period	53,805 [2] 54,310	55,933 [2] 59,935	51,945 [2] 51,747	54,345	60,408
Domestic demand	373,900	377,003	407,106	434,810	481,591
Kerosene:					
Production	43,836	48,977	53,855	55,813	56,082
Imports	71				1
Exports	11,044	8,959	9,781	6,651	6,886
Stocks, end of period	4,974 [2] 5,033	6,558	6,398	7,915	5,633
Domestic demand	33,221	38,493	44,234	47,645	51,479
Gas oil and fuel oil:					
Production [3]	301,353	316,439	335,353	360,061	411,338
Imports	21,286	13,215	12,634	16,130	19,135
Exports	19,994	20,563	28,605	28,948	34,280
Stocks, end of period [4]	129,881 [2] 130,753	123,500 [2] 123,004	110,397	103,984	106,918
Domestic demand	308,157	316,344	331,989	366,723	408,991
Lubricants:					
Production	22,433	23,775	26,373	27,853	30,905
Imports	12	1	2	1	3
Exports	6,851	8,218	7,660	8,499	8,315
Stocks, end of period	8,465 [2] 8,694	7,100	7,331	7,025	6,942
Domestic demand	16,614	17,152	18,484	19,661	22,676
Wax (thousands of pounds):					
Production	458,920	469,560	468,720	450,240	472,920
Imports	33,255	36,634	37,292	19,557	16,669
Exports	235,304	247,769	198,958	229,905	187,342
Stocks, end of period	163,628 [2] 163,935	69,117	136,136	114,675	115,434
Domestic demand	264,463	353,243	240,035	261,353	301,488

[1] Preliminary.
[2] For comparison with succeeding year.
[3] Includes transfers.
[4] California heavy crude included.

Runs to stills and production at refineries of the various refined products, 1932–36

[Thousands of barrels of 42 gallons, except as otherwise indicated]

	1932	1933	1934	1935	1936 [1]
Input:					
Crude petroleum:					
Domestic	777,696	825,786	860,776	933,659	1,034,201
Foreign	42,301	35,468	34,860	32,131	33,933
Total crude petroleum	819,997	861,254	895,636	965,790	1,068,134
Natural gasoline [2]	26,332	25,346	28,162	31,025	33,817
Total input	846,329	886,600	923,798	996,815	1,101,951
Output:					
Gasoline	392,623	401,591	416,932	457,842	504,724
Kerosene	43,836	48,977	53,855	55,813	56,082
Gas oil and distillate fuel oils	69,467	78,920	94,972	100,235	125,650
Residual fuel oils	225,283	237,519	240,381	259,826	285,688
Lubricants	22,433	23,775	26,373	27,853	30,905
Wax	1,639	1,677	1,674	1,608	1,689
Coke	9,123	7,900	6,500	7,290	6,891
Asphalt	13,612	12,757	15,623	17,133	23,024
Still gas	40,905	45,212	44,391	51,184	54,441
Wax ..... thousands of pounds	458,920	469,560	468,720	450,240	472,920
Coke ..... thousands of short tons	1,788.8	1,580.0	1,300.0	1,458.0	1,378.2
Asphalt ..... do	2,474.9	2,319.5	2,840.5	3,115.1	4,186.1
Still gas ..... millions of cubic feet	160,812	170,853	169,479	197,220	207,535
Road oil	6,879	5,534	6,210	6,030	7,636
Other finished products	1,738	1,435	1,872	1,888	2,199
Crude gasoline (net)	[3] 1,861	4,547	[3] 3,007	1,032	486
Other unfinished oils (net)			1,949	[3] 2,412	[3] 8,769
Shortage	20,652	16,756	16,073	11,493	11,305
Total output	846,329	886,600	923,798	996,815	1,101,951

[1] Preliminary.
[2] Includes natural gasoline run through pipe lines in California.
[3] Negative quantity; represents net excess of unfinished oils rerun over unfinished oils produced.

Runs to stills and production at refineries of the various refined products, 1935–36, by months

[Thousands of barrels of 42 gallons, except as otherwise indicated]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1935													
Input:													
Crude petroleum [1]	75,346	70,708	76,597	75,066	80,377	81,596	84,865	84,584	83,347	85,132	83,180	84,992	965,790
Natural gasoline [2]	2,438	2,155	2,025	1,959	1,973	2,218	2,257	2,567	2,937	3,717	3,470	3,309	31,025
Total input	77,784	72,863	78,622	77,025	82,350	83,814	87,122	87,151	86,284	88,849	86,650	88,301	996,815
Fresh cracking stocks charged to stills:													
Crude oil	5,434	4,627	5,053	4,459	5,133	5,120	5,909	5,258	5,820	6,161	4,910	5,620	63,504
Other oils	35,497	34,185	35,805	35,197	38,327	38,323	38,614	41,076	39,093	41,032	39,585	39,451	456,185
Output:													
Gasoline	35,341	32,719	35,346	34,747	37,599	38,201	40,686	40,500	39,820	41,956	40,260	40,667	457,842
Kerosene	5,011	4,791	5,215	4,325	4,474	4,417	4,212	4,390	4,498	4,978	4,878	4,624	55,813
Gas oil and distillate fuel oils	7,696	7,001	8,678	7,183	8,198	8,205	8,709	8,129	8,885	9,068	8,598	9,885	100,235
Residual fuel oils	20,545	19,480	20,822	19,618	21,704	20,754	20,950	21,807	22,166	23,277	23,660	25,043	259,826
Lubricants	2,212	2,073	2,251	2,309	2,392	2,247	2,213	2,399	2,357	2,463	2,453	2,484	27,853
Wax	132	126	133	154	147	112	116	125	130	140	149	144	1,608
Coke	580	550	594	602	660	676	699	655	614	593	539	528	7,290
Asphalt	813	736	991	1,348	1,619	1,781	1,835	1,946	1,743	1,838	1,354	1,129	17,133
Still gas	3,888	3,593	4,087	3,996	4,491	4,448	4,894	4,688	4,443	4,353	4,121	4,182	51,184
Wax ..... thousands of pounds	36,960	35,280	37,240	43,120	41,160	31,360	32,480	35,000	36,400	39,200	41,720	40,320	450,240
Coke ..... thousands of short tons	116.0	110.0	118.8	120.4	132.0	135.2	139.8	131.0	122.8	118.6	107.8	105.6	1,458.0
Asphalt ..... do	147.8	133.8	180.2	245.1	294.4	323.8	333.6	353.8	316.9	334.2	246.2	205.3	3,115.1
Still gas ..... millions of cubic feet	15,682	13,919	15,817	15,585	17,142	17,074	18,451	17,941	17,136	16,872	15,999	16,202	197,220
Road oil	146	151	146	382	603	873	1,060	1,223	813	263	197	173	6,030
Other finished products	171	159	186	150	155	167	154	158	125	152	143	168	1,888
Crude gasoline (net)	325	610	[3] 64	290	112	79	[3] 392	[3] 206	[3] 58	[3] 285	326	295	1,032
Other unfinished oils (net)	158	63	[3] 629	945	[3] 778	631	892	52	[3] 251	[3] 795	[3] 925	[3] 1,775	[3] 2,412
Shortage	766	811	866	976	974	1,223	1,094	1,285	999	848	897	754	11,493
Total output	77,784	72,863	78,622	77,025	82,350	83,814	87,122	87,151	86,284	88,849	86,650	88,301	996,815

1936 [4]													
Input:													
Crude petroleum [1]	85,776	81,523	85,286	84,545	90,637	89,003	91,709	93,444	90,872	93,146	89,142	93,051	1,068,134
Natural gasoline [2]	2,891	2,236	2,439	2,085	2,009	2,117	2,638	2,879	3,341	3,749	3,808	3,625	33,817
Total input	88,667	83,759	87,725	86,630	92,646	91,120	94,347	96,323	94,213	96,895	92,950	96,676	1,101,951
Fresh cracking stocks charged to stills:													
Crude oil	6,273	6,464	7,159	6,395	7,717	6,966	6,774	7,743	8,632	9,330	9,434	9,274	92,161
Other oils	38,196	36,252	38,544	39,171	42,095	41,686	45,288	45,308	43,004	43,837	42,463	44,125	499,969
Output:													
Gasoline	39,544	37,176	38,764	39,902	41,951	41,612	43,500	44,568	44,024	45,887	43,138	44,658	504,724
Kerosene	4,761	4,445	4,741	4,953	4,626	4,376	4,455	4,297	4,428	4,712	4,788	5,500	56,082
Gas oil and distillate fuel oils	10,587	11,125	10,262	9,553	10,169	9,567	10,323	10,627	10,095	10,266	11,201	11,875	125,650
Residual fuel oil	24,573	23,751	23,667	23,062	23,925	22,499	23,144	23,287	23,154	25,285	23,671	25,670	285,688
Lubricants	2,309	2,204	2,515	2,687	2,768	2,509	2,626	2,668	2,567	2,632	2,653	2,767	30,905
Wax	160	129	151	141	144	139	124	125	123	153	153	147	1,689
Coke	601	540	527	543	566	610	601	604	615	584	557	543	6,891
Asphalt	1,087	986	1,436	1,753	2,071	2,239	2,340	2,701	2,572	2,610	1,889	1,340	23,024
Still gas	4,102	3,833	4,136	4,366	4,818	4,831	4,951	4,947	4,743	4,680	4,437	4,597	54,441
Wax .... thousands of pounds	44,800	36,120	42,280	39,480	40,320	38,920	34,720	35,000	34,440	42,840	42,840	41,160	472,920
Coke .... thousands of short tons	120.2	108.0	105.4	108.6	113.2	122.0	120.2	120.8	123.0	116.8	111.4	108.6	1,378.2
Asphalt .... do	197.7	179.3	261.1	318.7	376.5	407.0	425.5	491.1	467.6	474.5	343.5	243.6	4,186.1
Still gas .... millions of cubic feet	15,885	14,843	15,419	16,549	18,265	18,038	18,623	18,901	18,110	18,035	17,191	17,676	207,535
Road oil	−31	178	170	401	767	1,276	1,464	1,274	937	578	309	313	7,636
Other finished products	200	193	247	140	198	192	172	181	151	206	170	149	2,199
Crude gasoline (net)	791	32	488	[3] 400	[3] 27	[3] 72	[3] 334	[3] 68	[3] 50	18	[3] 134	242	486
Other unfinished oils (net)	[3] 863	[3] 1,807	[3] 261	[3] 1,530	[3] 192	339	[3] 211	[3] 145	[3] 192	[3] 1,499	[3] 731	[3] 1,677	[3] 8,769
Shortage	846	974	882	1,059	862	1,003	1,192	1,257	1,046	783	849	552	11,305
Total output	88,667	83,759	87,725	86,630	92,646	91,120	94,347	96,323	94,213	96,895	92,950	96,676	1,101,951

[1] Details by districts and months on p. 988.
[2] Includes 745,000 barrels run through pipe lines in California in 1935 and 1,250,000 barrels in 1936.
[3] Negative quantity; represents net excess rerun over production.
[4] Preliminary.

Summary of percentage yields of refined products, 1932–36

[Computed on total crude runs to stills]

Product	1932	1933	1934	1935	1936 [1]
Gasoline [2]	44.7	43.7	43.4	44.2	44.1
Kerosene	5.3	5.7	6.0	5.8	5.3
Gas oil and distillate fuel oils	8.5	9.2	10.6	10.4	11.8
Residual fuel oils	27.5	27.6	26.8	26.9	26.7
Lubricants	2.7	2.8	2.9	2.9	2.9
Wax	.2	.2	.2	.2	.2
Coke	1.1	.9	.7	.7	.6
Asphalt	1.7	1.5	1.7	1.8	2.2
Road Oil	.8	.6	.7	.6	.7
Still gas	5.0	5.2	5.0	5.3	5.1
Other finished products	.2	.2	.2	.2	.2
Shortage	2.5	1.9	1.8	1.2	1.0

[1] Preliminary. [2] Based on total gasoline production less natural gasoline used.

MOTOR FUEL

Demand.—The domestic motor-fuel demand of 481,591,000 barrels in 1936 is an increase of 10.8 percent over the former high record of 434,810,000 barrels—that for 1935. The most significant factor in this higher motor-fuel demand was an increase of 2 million automobiles in motor-vehicle registrations, whieh is reflected in a slightly smaller advance in motor vehicles in use. Although the motor-fuel demand per motor vehicle rose about 0.90 barrel in 1936—from 17.81 to 18.71 barrels per vehicle—the increase during the past few years has not been as large as might be expected from the combined influence of the trend and recovery, indicating that the trend is not increasing at as rapid a rate as heretofore.

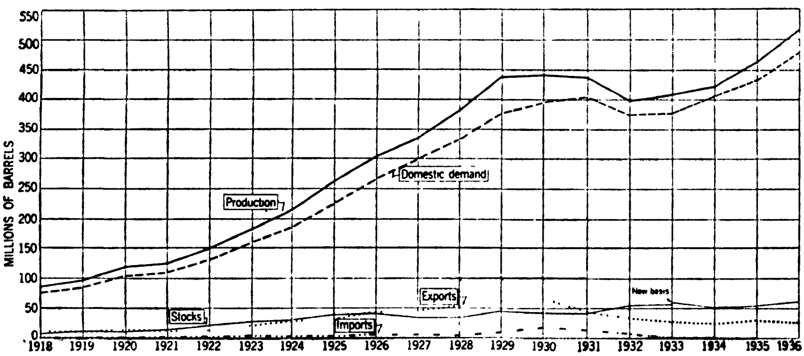


FIGURE 72.—Trends in production, domestic demand, exports, imports, and stocks of motor fuel, 1918–36.

The number of motor vehicles in use on July 1, 1936, is estimated as 25,643,000, compared with 24,294,000 on the same date in 1935. Both of these figures are based upon preliminary estimates of registrations, and the 1936 figure is also based upon the estimated number of cars scrapped, as these statistics cannot be calculated until information on the 1937 registrations is available. This increase of 1,349,000 is to be compared with an advance of 811,000 from 1934 to 1935 and of 738,000 from 1933 to 1934.

Domestic demand per motor vehicle in use, 1924–36

Year	Domestic demand for motor fuel [1] (barrels)	Motor vehicles in use July 1	Motor-fuel demand per motor vehicle in use (barrels)			Federal Reserve bank index of total volume of trade
			Actual	1924-31 [2] trend	Deviation from trend	
1924	187,022,000	16,022,000	11.67	11.94	−0.27	0.00
1925	226,329,000	17,808,000	12.71	12.64	.07	.03
1926	234,391,000	19,784,000	13.36	13.36	.00	.05
1927	299,818,000	21,297,000	14.08	14.07	.01	.04
1928	332,033,000	22,025,000	15.08	14.77	.31	.05
1929	375,999,000	23,733,000	15.84	15.48	.36	.07
1930	394,800,000	24,710,000	15.98	16.19	−.21	−.08
1931	403,418,000	24,263,000	16.63	16.90	−.27	−.22
1932	373,900,000	23,206,000	16.11	17.61	−1.50	−.30
1933	377,003,000	22,745,000	16.58	18.32	−1.74	−.38
1934	407,106,000	23,483,000	17.34	19.03	−1.69	−.37
1935	432,556,000	24,294,000	17.81	19.73	−1.92	−.34
1936	479,660,000	25,643,000	18.71	20.44	−1.73	−.27

[1] Natural gasoline losses not included.
[2] Least squares straight-line trend based on 1924-31 data. Depression years have been omitted because they are not normal.

Although it is often difficult to account for the fluctuations from month to month, extreme weather conditions in 1936 showed their influence on gasoline consumption. The gasoline temperature index (an index computed by weighting the temperature deviations from normal in the various parts of the country by the gasoline consumption) was 6.1° below normal for February, the greatest minus deviation for any month in 12 years, and the motor-fuel demand was about 4 percent below normal. The gasoline temperature index for December was +3.1°, the highest plus deviation for any December during the past 12 years, and the demand was about 8 percent above normal. While there were probably other factors besides weather that entered into the abnormally high demand for this month, it is safe to assume that mild weather, combined with the holiday season, had a material influence upon gasoline consumption.

Production, demand, and stocks of motor fuel, 1935–36

[Thousands of barrels of 42 gallons]

Month	Production		Demand				Stocks at end of month	
			Domestic		Exports			
	1935	1936 [1]	1935	1936 [1]	1935	1936 [1]	1935	1936 [1]
January	36,379	40,492	28,147	32,412	2,133	2,572	57,846	59,853
February	33,702	38,310	26,580	27,216	1,248	1,668	63,720	69,279
March	36,741	39,888	32,272	35,871	2,582	1,615	65,607	71,681
April	36,027	41,286	36,363	38,825	1,467	2,532	63,804	71,610
May	38,897	43,438	39,381	42,007	2,147	2,702	61,173	70,339
June	39,177	42,930	38,086	44,630	3,222	2,291	59,042	66,348
July	41,747	44,427	41,479	46,638	3,022	2,369	56,288	61,768
August	41,190	45,415	43,097	46,081	2,821	2,409	51,560	58,693
September	40,282	44,483	37,976	44,346	3,109	2,491	50,757	56,339
October	42,027	46,198	41,566	44,253	2,461	2,491	48,757	55,793
November	40,607	43,374	35,991	39,919	3,158	2,586	50,215	56,662
December	41,245	45,244	38,872	39,398	3,243	2,105	54,345	60,408
	468,021	515,485	434,810	481,591	30,613	27,831	--------	--------

[1] Preliminary.

Distribution of motor-fuel demand by uses must be estimated. The figures for bus use are based upon a study made by the Bureau of gasoline consumption by busses (Information Circular 6639). The proportion of highway and city gasoline consumption was determined from mileage studies by the Bureau of Public Roads. The trends in proportion of traffic on the highways were determined from traffic over toll bridges, and the trends in the proportion of traffic in cities were determined from traffic surveys.

Distribution of automotive motor-fuel demand, 1925–36

[Thousands of barrels of 42 gallons]

Year	Motor-fuel demand		Busses	Passenger cars			Trucks		
	Total	Automotive, 89 percent		Highway	City	Total	Highway	City	Total
1925	226,329	201,433	3,391	80,653	74,285	154,938	8,466	34,638	43,104
1926	264,391	235,308	4,649	93,666	87,573	181,239	10,131	39,289	49,420
1927	299,818	266,839	5,458	105,553	100,430	205,983	12,068	43,329	55,397
1928	332,033	295,509	7,248	115,422	112,075	227,497	14,295	46,469	60,764
1929	375,999	334,649	9,394	128,943	127,956	256,899	17,417	50,929	68,346
1930	394,800	351,372	10,885	133,454	136,893	270,347	19,765	50,375	70,140
1931	403,418	359,042	11,468	134,276	142,552	276,828	22,132	48,614	70,746
1932	373,900	332,771	11,450	122,355	134,613	256,968	22,239	42,114	64,353
1933	377,003	335,533	11,450	121,966	135,335	257,301	23,871	42,911	66,782
1934	410,339	365,200	12,500	131,183	146,565	277,748	27,532	47,420	74,952
1935	434,810	386,981	13,500	137,316	154,440	291,756	30,750	50,975	81,725
1936	481,591	428,600	14,500	150,885	170,116	321,001	35,460	57,639	93,099

Production.—The 515,485,000 barrels of motor fuel produced in 1936 comprised 231,287,000 barrels of straight-run gasoline, 239,620,000 barrels of cracked gasoline, 33,817,000 barrels of blended natural gasoline, 8,224,000 barrels of unblended natural gasoline, and 2,537,000 barrels of benzol. The ratio of straight-run gasoline to total motor-fuel production continued its decline from 48.8 percent in 1934 and 46.9 in 1935 to 44.9 in 1936. The ratio of cracked gasoline, on the other hand, continued to increase in comparable proportions, rising from 43 percent in 1934 and 44.3 in 1935 to 46.5 in 1936. The ratio of natural gasoline declined from 8.4 to 8.2 percent, while the proportion of benzol remained 0.4 percent. The decline in the proportion of natural gasoline probably reflects the tendency to use still gases to obtain lighter-volatility gasoline instead of natural gasoline.

The increase in gasoline production from 458 million barrels in 1935 to 505 million in 1936 was distributed among the various districts, as the accompanying table shows. The most significant gain was in the Texas Gulf district, which produced 14,807,000 barrels more in 1936 than in 1935; this was 32 percent of the increase for the whole country and represents a gain of about 17 percent for that district. Although the Louisiana Inland-Arkansas district produced 36 percent more in 1936 than in 1935, production in 1935 had declined considerably from the previous year, and the 1936 production is only 15 percent above that of 1934. Texas Inland and Indiana-Illinois, with increases of 13 and 12 percent, respectively, were the next most important districts. The Appalachian district declined slightly, and the gain in the East Coast district was only 3 percent.

The last two columns of the table indicate the trends of production in the various districts at the end of the year. The average monthly

production in the Texas Inland, Indiana-Illinois, Texas Gulf, Rocky Mountain, and Louisiana Inland-Arkansas districts was 9 to 10 percent higher during the last 3 months of the year than for the whole year, while the change for California and Louisiana Gulf was negligible.

Gasoline production by refinery districts, 1935–36, including natural gasoline

[Thousands of barrels of 42 gallons]

District	1935		1936		1936 [1]	
					Last 3 months	
	Total year	Monthly average	Total year	Monthly average	Total	Monthly average
East Coast	72,466	6,039	74,558	6,213	19,277	6,426
Appalachian	19,016	1,585	18,656	1,555	4,922	1,641
Indiana-Illinois	76,442	6,370	85,812	7,151	23,489	7,829
Oklahoma-Kansas	62,529	5,211	65,837	5,486	17,061	5,687
Texas Inland	33,958	2,830	38,343	3,195	10,522	3,507
Texas Gulf	89,525	7,460	104,332	8,694	28,472	9,491
Louisiana Gulf	16,201	1,350	17,961	1,497	4,505	1,502
Arkansas-Louisiana Inland	7,679	640	10,439	870	2,846	948
Rocky mountain	10,705	892	11,844	987	3,234	1,078
California	69,321	5,777	76,942	6,412	19,355	6,452
Total United States	457,842	38,154	504,724	42,060	133,683	44,561

[1] Preliminary.

The average yield of gasoline in 1936 was 44.1 percent of crude run to stills compared with 44.2 percent in 1935 and 44.7 percent in the peak year of 1932. The yield of cracked gasoline for the first time exceeded that of straight-run, being 22.4 percent compared with 21.5 percent in 1935. The yield of straight-run gasoline declined to 21.7 percent from 22.7 percent for 1935. This represents a decline of almost 3 percent from the 1931 high of 24.6 percent. The increasing percentage of cracked gasoline and the declining percentage of straight-run gasoline is due to the re-forming or cracking of straight-run gasoline to obtain higher antiknock values; this is evidenced in the failure of the total yield to increase, due to losses in re-forming. Combined with this as a cause for keeping the total yield low was the strong market for heating oil, which demanded material that otherwise would be used for cracking stock.

This effort to supply the heating-oil market was quite evident in the east-coast district, where the yield dropped from 41.7 percent in 1935 to 39.6 percent in 1936. The average yield for the last 4 months of 1936 was 38.6 percent as against 43 percent for the same period of 1935. The yield in the Appalachian district, continuing a trend of several years, fell from 48.6 percent in 1935 to 47.5 in 1936, although this trend reversed itself during the last half of the year. Both Inland Texas and California showed an increase in the percentage yield from cracking, which raised the total percentage yield for the former district from 48.2 percent in 1935 to 50.2 in 1936, and for the latter district from 32.5 percent in 1935 to 34.3 in 1936.

Production of gasoline in 1936,[1] by methods of manufacture, districts, and months

[Thousands of barrels of 42 gallons]

Method and district	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total: Quantity	Total: Percent of total
Straight distillation:														
East Coast	2,372	2,234	2,391	2,496	2,770	2,727	2,497	2,674	2,376	2,447	2,357	2,410	29,751	39.9
Appalachian	816	701	722	745	821	721	829	786	776	789	837	851	9,394	50.3
Indiana, Illinois, Kentucky, etc	2,610	2,448	2,506	2,760	2,786	3,096	3,092	3,040	3,297	3,537	2,982	3,098	35,252	41.1
Oklahoma, Kansas, and Missouri	2,639	2,359	2,492	2,702	3,085	3,013	3,021	2,962	2,898	2,813	2,742	2,879	33,605	51.0
Texas Inland	1,695	1,528	1,752	1,644	1,728	1,806	1,968	1,966	1,743	1,730	1,616	1,726	20,902	54.5
Texas Gulf Coast	3,639	3,283	2,890	3,836	3,270	3,295	3,430	3,440	3,577	3,844	3,317	3,395	41,216	39.5
Louisiana Gulf Coast	834	733	698	794	699	743	819	766	808	893	633	421	8,841	49.2
Arkansas-Louisiana Inland	359	437	404	437	430	458	511	543	481	509	431	551	5,554	53.2
Rocky Mountain	441	444	439	454	478	464	538	530	477	518	519	509	5,811	49.0
California	3,792	3,470	3,502	3,383	3,564	3,453	3,397	3,585	3,394	3,292	2,891	3,238	40,961	53.2
Total straight run	19,197	17,637	17,796	19,251	19,631	19,776	20,102	20,292	19,830	20,372	18,325	19,078	231,287	45.8
Percent of total production	48.6	47.4	45.9	48.3	46.8	47.5	46.2	45.5	45.0	44.4	42.5	42.7	45.8	
Cracking:														
East Coast	3,254	3,373	3,526	3,394	3,576	3,649	3,736	3,744	3,845	3,914	3,831	3,801	43,643	58.5
Appalachian	671	666	684	720	730	734	778	822	822	764	783	793	8,967	48.1
Indiana, Illinois, Kentucky, etc	3,124	3,129	3,526	3,930	4,227	3,951	4,191	4,114	3,967	4,445	3,989	4,201	46,794	54.5
Oklahoma, Kansas, and Missouri	2,137	1,807	1,964	2,114	2,154	2,217	2,302	2,272	2,292	2,328	2,100	2,179	25,866	39.3
Texas Inland	925	866	831	880	927	914	1,142	1,364	1,224	1,279	1,384	1,279	13,015	34.0
Texas Gulf Coast	4,377	4,206	4,671	4,312	5,255	4,837	4,948	5,165	5,055	5,344	5,239	5,651	59,060	56.6
Louisiana Gulf Coast	693	692	629	626	694	701	770	792	755	825	664	957	8,798	49.0
Arkansas-Louisiana Inland	292	340	331	346	352	378	363	365	365	384	338	466	4,320	41.4
Rocky Mountain	395	390	423	412	432	417	432	443	434	435	442	458	5,113	43.2
California	1,588	1,834	1,944	1,832	1,964	1,921	2,098	2,316	2,094	2,048	2,235	2,170	24,044	31.3
Total cracked	17,456	17,303	18,529	18,566	20,311	19,719	20,760	21,397	20,853	21,766	21,005	21,955	239,620	47.5
Percent of total production	44.1	46.6	47.8	46.5	48.4	47.4	47.7	48.0	47.4	47.4	48.7	49.2	47.5	
Natural gasoline blended at refineries	2,891	2,236	2,439	2,085	2,009	2,117	2,638	2,879	3,341	3,749	3,808	3,625	33,817	6.7
Percent of total production	7.3	6.0	6.3	5.2	4.8	5.1	6.1	6.5	7.6	8.2	8.8	8.1	6.7	

[1] Preliminary.

Total:														
East Coast	5,752	5,658	5,981	5,925	6,381	6,417	6,342	6,495	6,330	6,515	6,363	6,399	74,558	--------
Appalachian	1,516	1,389	1,432	1,486	1,568	1,476	1,624	1,627	1,616	1,579	1,658	1,685	18,656	--------
Indiana, Illinois, Kentucky, etc	6,091	5,884	6,368	6,955	7,275	7,267	7,513	7,388	7,582	8,409	7,369	7,711	85,812	--------
Oklahoma, Kansas, and Missouri	5,375	4,608	4,861	5,238	5,632	5,655	5,808	5,779	5,820	5,859	5,537	5,665	65,837	--------
Texas Inalnd	3,032	2,665	2,867	2,754	2,855	3,016	3,475	3,729	3,428	3,522	3,501	3,499	38,343	--------
Texas Gulf Coast	8,282	7,709	7,739	8,295	8,717	8,331	8,714	8,945	9,128	9,766	9,179	9,527	104,332	--------
Louisiana Gulf Coast	1,561	1,456	1,355	1,435	1,411	1,462	1,611	1,582	1,583	1,746	1,340	1,419	17,961	--------
Arkansas-Louisiana Inland	696	811	771	814	819	881	930	965	906	955	818	1,073	10,439	--------
Rocky Mountain	940	915	925	930	964	929	1,019	1,022	966	1,066	1,084	1,084	11,844	--------
California	6,299	6,081	6,465	6,070	6,329	6,178	6,464	7,036	6,665	6,470	6,289	6,596	76,942	--------
Total, 1936	39,544	37,176	38,764	39,902	41,951	41,612	43,500	44,568	44,024	45,887	43,138	44,658	504,724	100.0
Total, 1935	35,341	32,719	35,346	34,747	37,599	38,201	40,686	40,500	39,820	41,956	40,260	40,667	457,842	--------
Daily average, 1936	1,276	1,282	1,250	1,330	1,353	1,387	1,403	1,438	1,467	1,480	1,438	1,441	1,379	--------

Prices.—Although the average refinery price of regular-grade gasoline in Oklahoma was 5.60 cents for 1936 compared with 5.37 cents for 1935, gasoline prices as a whole did not improve during the year. The price at the beginning of the year was 5.63–5.75 cents and; coincident with the crude-oil price increase, rose in the second week in January to 6.13–6.25 cents. In the first week of February prices began to drift off, reaching a low for the year of 4.88–5.38 cents in September and October, from which they recovered to 5.13–5.38 cents in December.

On April 15, 1936 the regular grade of 63–70 octane gasoline was changed to 63–67 octane, and a new grade of 68–70 was added, probably accounting wholly for the price being lower at the end of the year than it was at the beginning, as in other grades the prices for the two periods were the same.

Gasoline prices, 1932–36, in cents per gallon

Year	Refinery [1]	Service-station [2]		Year	Refinery [1]	Service-station [2]	
		Ex tax	Including State gasoline taxes			Ex tax	Including State gasoline taxes
1932	4.66	13.30	17.43	1935	5.37	13.55	17.84
1933	3.92	12.41	16.57	1936	5.60	14.10	18.44
1934	4.75	13.64	17.84				

[1] Regular-grade gasoline f. o. b. cars at Oklahoma refineries; from Oil Price Handbook.
[2] American Petroleum Institute.

The average A. P. I., 50-city, service-station price ex tax rose from 13.55 cents per gallon in 1935 to 14.10 cents in 1936. The largest change came during January, when the average price increased from 13.70 cents on January 1 to 14.26 cents on February 1, coincident with the increase of 10 cents per barrel in the price of crude oil. The February average price was the highest of the year, the increase of 0.24 cent per gallon for crude oil not being able to support the increase of 0.55 cent per gallon for gasoline; and declines during March brought the April 1 average to 13.85 cents, the lowest for the year except that for January. These declines, except that for Dover, Del., where the price dropped 2 cents on March 19, occurred in the western part of the United States. Gasoline prices dropped 3 cents in Reno, Nev., 2.5 cents in Seattle, Wash., Portland, Oreg., San Francisco, Calif., and Phoenix, Ariz.; and 2 cents in Denver, Colo. The price average recovered to 14.23 cents by May 1 and varied from that but slightly until the seasonal winter decline brought it to 13.96 cents in November and December. During December price increases in several cities brought the average to 14.13 cents by the end of the month.

The price was highest in Twin Falls, Idaho, where the rate of 25 cents per gallon, including a 6-cent tax, prevailed throughout the year. Next in order were Boise, Idaho, which opened the year with a price of 24.5 cents; Montgomery, Ala., 24 cents; Helena, Mont., and Birmingham, Ala., 23.5 cents; and Butte, Mont., Atlanta, Ga., and Pensacola, Fla., 23 cents. Billings, Helena, and Great Falls, Mont., all closed the year with a price of 24.5 cents.

The lowest price at the beginning of the year was at Los Angeles, where gasoline sold at 15.5 cents, including a 4-cent tax, while the price at San Francisco was 16.5 cents. On March 3 the price was reduced to 13.5 cents in both cities until April 1, when the cut was restored, and the price was 17.5 cents in Los Angeles and 18 cents in San Francisco at the end of the year. In Providence, R. I., where the price at the beginning of the year was 16 cents, including a 3-cent tax, gasoline sold for as low as 14.5 cents during part of October and November and closed the year at 15.3 cents, the lowest in the country.

The average tank-wagon price for 1936 was 12.62 cents per gallon, 0.6 cent higher than the average for 1935. The price ranged from a low of 12.11 cents on January 1 to 12.80 during the summer months and was 12.54 cents on December 1. The differential between the average service-station and the average tank-wagon price for 1936 was 1.48 cents, compared with a differential of 1.53 cents for 1935.

State gasoline tax rates ranged from 2 cents per gallon in Missouri, Rhode Island, and the District of Columbia to 7 cents in Florida, Louisiana, and Tennessee, in addition to a Federal tax of 1 cent per gallon plus various municipal and county taxes. The tax rate was increased from 5 to 7 cents per gallon in Louisiana on July 28, while it was decreased from 4 to 3 cents per gallon in New York on July 1. At the end of the year there were 2 States and the District of Columbia with a tax rate of 2 cents, 11 States with a tax rate of 3 cents, 17 States with a tax rate of 4 cents, 9 States with a tax rate of 5 cents, 5 States with a tax rate of 6 cents, 1 State with a tax rate of 6½ cents, and 3 States with a tax rate of 7 cents.

Stocks.—Motor-fuel stocks, including stocks of gasoline at refineries, at bulk terminals, and in pipe lines and stocks of natural gasoline amounted to 60,408,000 barrels on December 31, 1936, compared with 54,345,000 barrels on the same date in the previous year. The quantity of motor fuel on hand at the end of 1936 was 45.91 times the average daily demand during the year compared with 45.62 for the motor fuel on hand at the end of 1935. Early in the year, when the demand for fuel oil necessitated heavy runs to stills and excessive gasoline production, stocks began to increase out of proportion to the usual seasonal gain, reaching a peak of 71,681,000 barrels at the end of March, from which they declined to a low of 55,793,000 barrels at the end of October.

The largest increase was in the Gulf Coast district, where the gain of 2,213,000 barrels represented 37 percent of the total. California was next, with an increase of 1,666,000 barrels—27 percent of the total.

Consumption by States.—Figure 73 shows the gasoline consumption by States. New York used more gasoline than any other State again in 1936, having consumed 40,996,000 barrels (9 percent of the total for the United States). Other important consuming States were California, with 39,371,000 barrels (8 percent); Pennsylvania, 30,556,000 barrels (7 percent); Illinois, 28,379,000 barrels (6 percent); and Ohio, 27,807,000 barrels (6 percent). The demand of these five States represents 35.8 percent of the total United States demand in 1936 compared with 36.1 percent in 1935.

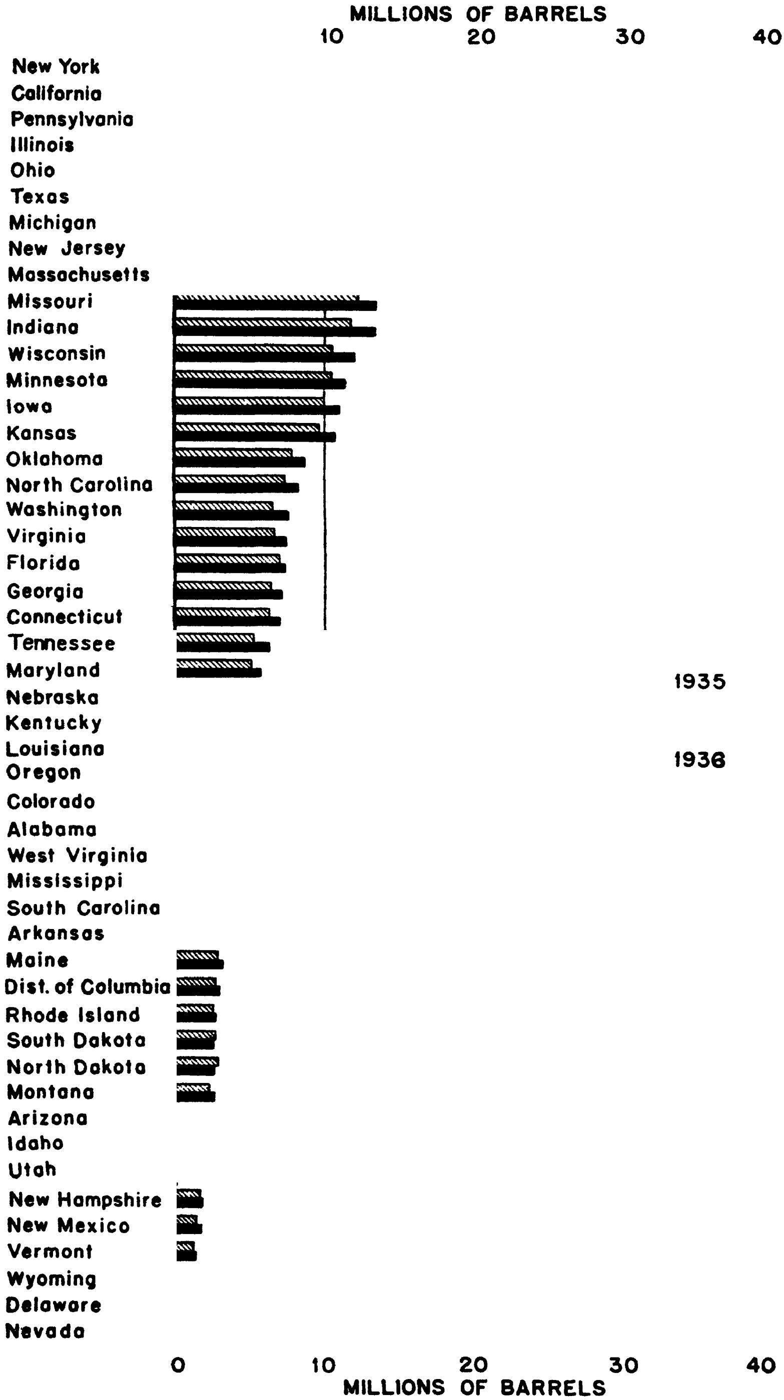


FIGURE 73.—Gasoline consumption, 1935–36, by States.

Consumption of gasoline, 1919–36, by States and years [1]

[Thousands of barrels of 42 gallons]

[The figures represent quantities of gasoline sold or offered for sale, as reported by wholesalers and dealers in the various States under provisions of the gasoline-tax or inspection laws. Such laws were not in operation in all States prior to 1930]

State	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936
Alabama					898	2,070	2,548	3,046	3,505	4,007	4,242	4,108	3,873	3,248	3,188	3,692	4,106	4,872
Arizona			209	416	479	580	679	776	982	1,365	1,735	1,810	1,773	1,657	1,536	1,743	1,928	2,277
Arkansas			248	520	996	1,359	1,989	2,384	2,366	2,838	3,205	3,301	3,026	2,715	2,886	3,337	3,414	3,672
California					3,593	15,969	19,325	21,569	24,230	26,224	29,841	31,799	33,370	32,204	31,512	31,766	35,910	39,371
Colorado	701	1,091	1,536	1,651	1,756	2,194	2,351	2,676	3,076	3,381	3,703	4,068	4,202	3,783	3,808	4,113	4,342	4,875
Connecticut			530	1,748	2,096	2,553	3,020	3,202	3,808	4,341	4,818	5,317	5,927	5,838	5,908	6,070	6,426	7,129
Delaware					250	378	425	476	578	660	776	857	907	911	957	995	1,081	1,204
District of Columbia						578	1,067	1,214	1,376	1,514	1,711	1,918	2,226	2,445	2,497	2,563	2,768	3,029
Florida			667	1,513	2,121	2,992	5,047	6,833	5,904	5,402	5,336	5,421	5,523	4,974	4,894	5,721	7,112	7,393
Georgia			720	1,795	2,431	2,828	3,478	4,052	4,578	4,908	5,252	5,338	5,283	4,739	5,014	5,702	6,394	7,202
Idaho					472	649	763	939	1,008	1,194	1,312	1,459	1,423	1,247	1,246	1,566	1,729	2,092
Illinois										996		23,172	24,945	22,639	23,119	24,427	25,458	28,379
Indiana					3,432	5,760	6,602	7,285	8,333	9,249	10,288	10,596	11,464	10,429	10,453	11,082	11,829	13,367
Iowa								5,976	7,359	7,301	7,991	9,305	9,820	8,487	8,466	9,614	10,027	10,957
Kansas							5,041	5,734	6,443	7,516	8,594	9,208	11,559	8,347	8,332	9,019	9,731	10,722
Kentucky		401	1,050	1,241	1,620	1,885	2,376	2,472	2,816	3,210	3,686	4,007	4,195	3,906	3,959	4,390	4,794	5,437
Louisiana			99	1,324	1,825	2,378	3,210	3,723	3,610	4,025	4,209	4,399	4,475	3,953	3,884	4,249	4,512	5,152
Maine					681	1,242	1,388	1,480	1,779	1,957	2,287	2,588	2,767	2,636	2,562	2,786	2,884	3,203
Maryland				942	1,757	1,955	2,435	2,807	3,131	3,413	3,888	4,342	4,498	4,618	4,548	4,911	5,183	5,839
Massachusetts											11,950	12,764	13,743	13,542	13,361	13,995	14,543	15,661
Michigan								12,807	14,128	16,032	18,697	18,876	19,561	18,216	17,626	18,618	21,077	23,709
Minnesota							5,857	6,337	6,897	7,820	8,521	9,558	10,522	9,550	9,565	9,941	10,542	11,449
Mississippi				711	1,173	1,526	2,042	2,521	2,804	3,075	3,368	3,220	2,743	2,554	2,753	3,125	3,455	4,069
Missouri							6,171	6,899	7,692	8,452	9,356	10,601	11,728	10,921	11,092	11,652	12,187	13,514
Montana			412	590	766	819	943	1,157	1,268	1,768	1.885	1,845	1,801	1,616	1,663	2,035	2,294	2,606
Nebraska							3,370	3,704	4,040	4,725	5,355	5,450	5,433	4,736	4,636	5,318	5,514	5,485
Nevada					138	184	220	258	303	342	424	443	561	555	491	648	718	815
New Hampshire					435	731	852	927	1,089	1,149	1,389	1,541	1,626	1,565	1,568	1,682	1,760	1,926
New Jersey										10,056	11,859	13,047	16,932	16,638	16,637	18,847	16,566	17,750
New Mexico	103	137	255	375	379	445	500	589	730	876	1,090	1,301	1,243	1,113	1,151	1,337	1,484	1,806
New York											23,819	36,000	38,704	37,800	36,714	37,362	38,346	40,996
North Carolina			1,205	1,924	2,935	3,655	4,380	4,635	5,228	5,859	6,312	5,968	6,088	5,526	5,748	6,662	7,376	8,289
North Dakota	836	426	349	378	955	1,200	1,580	1,809	2,111	2,790	2,961	2,858	2,733	2,331	2,374	2,451	2,859	2,652
Ohio								16,194	18,349	20,491	22,704	23,228	23,448	21,502	21,110	23,439	24,870	27,807
Oklahoma					1,426	3,525	4,351	5,104	5,987	6,685	7,531	7,693	7,151	6,384	6,550	7,153	7.869	8,708
Oregon	869	1,137	1,277	1,423	1,832	2,135	2,406	2,821	3,116	3,435	3,897	4,052	4,156	3,767	3,783	4,037	4,429	5,138
Pennsylvania			1,989	7,409	8,128	10,821	12,502	14,009	16,466	18,072	21,440	22,115	25,300	24,787	24,963	27,195	28,041	30,554

[1] 1919–24, Bureau of Public Roads; 1925–36, American Petroleum Institute.

Consumption of gasoline, 1919–36, by States and years—Continued

State	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936
Rhode Island								1,315	1,463	1,568	1,853	2,115	2,337	2,406	2,386	2,516	2,605	2,818
South Carolina				914	1,358	1,765	2,021	2,186	2,423	2,618	2,824	2,838	2,887	2,485	2,665	3,151	3,446	3,903
South Dakota				878	892	1,362	1,790	1,797	2,096	2,635	2,951	3,347	3,203	2,636	2,389	2,607	2,833	2,700
Tennessee					1,461	2,157	2,905	3,075	3,547	4,078	4,644	5,125	5,104	4,303	4,409	5,049	5,342	6,341
Texas					4,006	8,992	11,052	12,253	14,082	15,972	18,324	19,202	19,669	17,883	18,438	20,834	22,846	26,101
Utah					469	671	759	855	995	1,134	1,346	1,432	1,457	1,291	1,303	1,527	1,692	1,927
Vermont					421	555	616	658	790	888	1,047	1,119	1,170	1,116	1,051	1,197	1,253	1,429
Virginia					1,220	2,538	3,063	3,402	3,971	4,368	4,960	5,439	5,813	5,464	5,558	6,170	6,724	7,537
Washington			1,123	2,270	2,919	3,239	3,981	4,406	4,843	5,406	6,035	6,456	6,491	5,865	5,635	6,348	6,635	7,607
West Virginia					642	1,520	1,841	2,041	2,444	2,651	3,013	3,343	3,428	3,086	3,074	3,515	3,788	4,198
Wisconsin								6,397	7,466	8,504	9,367	10,426	10,849	9,730	9,226	10,017	10,534	12,012
Wyoming					356	482	495	552	624	757	823	872	940	842	844	1,047	1,179	1,397
Total	2,509	3,192	11,669	28,022	56,318	93,692	135,341	195,352	219,834	255,707	322,619	375,287	398,077	368,986	367,532	397,216	422,435	467,075

The only States where consumption was less than in 1935 were Nebraska, North Dakota, and South Dakota. Consumption in North Dakota in 1936 was 7 percent less than in 1935, when it was 17 percent above the level in 1934, the greatest gain made by any State. Wyoming was again one of the States to show a large increase, the gain this year being 19 percent compared with 13 percent in 1935. In New Mexico consumption was 22 percent greater than in 1935. Increases of approximately 18 percent were registered in Arizona, Alabama, and Tennessee. It is likely that a large part of the apparent increase in Tennessee represents more efficient tax collections rather than an actual gain in consumption.

Distribution.—There were no motor-fuel imports in 1936, and exports declined from 30,613,000 barrels in 1935 to 27,831,000 in 1936, continuing the downward trend that was interrupted by war buying in 1935.

Exports, by districts and months, are shown in the following table:

Motor fuel exports in 1936, by districts and months

[Thousands of barrels of 42 gallons]

District	January	February	March	April	May	June
East Coast	400	128	513	520	563	176
Appalachian	50	8	5	9	8	6
Indiana-Illinois	6	10	11	7	11	8
Texas Gulf	1,177	573	640	1,145	743	1,104
Texas Inland	3	4	3	4	3	3
Louisiana Gulf	22	54	31	39	93	5
Rocky Mountain	10	5	11	11	25	26
California	904	886	401	797	1,256	963
	2,572	1,668	1,615	2,532	2,702	2,291

District	July	August	September	October	November	December	Total
East Coast	143	232	226	324	249	322	3,796
Appalachian	9	5	4	20	19	7	150
Indiana-Illinois	7	7	6	9	14	4	100
Texas Gulf	878	1,003	920	904	798	924	10,809
Texas Inland	4	4	3	10	10	16	67
Louisiana Gulf	86	187	19	217	11	132	896
Rocky Mountain	30	32	27	25	19	14	235
California	1,212	939	1,286	982	1,466	686	11,778
	2,369	2,409	2,491	2,491	2,586	2,105	27,831

The amount of motor fuel transported by pipe line increased from 50,198,000 barrels in 1935 to 58,436,000 in 1936.

Shipments of motor fuel by pipe lines in 1936, by months

[Thousands of barrels of 42 gallons]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Motor fuel turned into lines	4,235	3,740	3,934	4,562	4,990	5,196	5,733	5,777	5,292	5,392	4,805	5,217	58,873
Motor fuel delivered from lines	4,183	3,175	3,987	4,546	5,049	5,416	5,712	5,824	5,342	5,420	4,802	4,980	58,436
Shortage	12	21	31	31	21	21	27	21	35	30	31	17	298
Stocks in lines and working tanks, end of month	2,577	3,121	3,037	3,022	2,942	2,701	2,695	2,627	2,542	2,484	2,456	2,676	2,676

Data are not sufficiently complete to show the distribution of motor fuel in 1936 by districts, but a few of the movements for which statistics are available are shown in the accompanying table.

Interregional shipments of gasoline in 1936

[Thousands of barrels of 42 gallons]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
From California:													
To Texas	51	48	82	81	89	101	14	128	122	109	79	77	981
To Rocky Mountain	58	43	62	69	91	95	111	129	115	100	92	36	1,001
To East Coast	523	311	698	843	498	743	608	633	610	117	197	34	5,815
From Gulf ports:													
To East Coast	5,937	5,822	7,662	7,703	8,154	7,487	7,909	8,390	7,964	8,837	7,260	7,433	90,558

KEROSENE

Domestic demand for kerosene continued its upward trend in 1936, amounting to 51,479,000 barrels—3,834,000 barrels more than in 1935. This increase may be attributed to the growth in its use for domestic cooking and heating or as range-oil fuel. The following table shows the annual kerosene demand from 1931 to 1936:

Domestic demand for kerosene, 1932–36

[Thousands of barrels of 42 gallons]

Year	Range oil	Other uses	Total	Year	Range oil	Other uses	Total
1932	6,841	26,380	33,221	1935	21,526	26,119	47,645
1933	9,849	28,644	38,493	1936	[1] 26,000	25,479	51,479
1934	15,756	28,478	44,234				

[1] Estimated.

Exports of kerosene total 6,886,000 barrels, slightly more than the 6,651,000 barrels exported in 1935. The percentage yield of kerosene declined for the second successive year to 5.3 percent from 5.8 percent in 1935. Although the domestic demand for kerosene increased 3,834,000 barrels in 1936, production increased only 269,000 barrels—from 55,813,000 barrels in 1935 to 56,082,000 in 1936, the difference being drawn from stocks, which declined from 7,915,000 barrels to 5,633,000 during the year.

The tank-wagon price for kerosene at Chicago, which remained at 9.8 cents per gallon from May 1935 to March 1936, rose during the last week of that month to 10.1 cents and remained at that figure throughout the summer. It dropped to 9.2 cents on September 1 but recovered to 9.5 cents on the first of December, where it stayed for the rest of the year. The average refinery price of kerosene increased for the fourth consecutive year, averaging 3.85 cents for 1936 compared with 3.70 cents for 1935.

GAS OIL AND FUEL OIL [2]

In 1936 it was necessary to increase substantially the production of both light and heavy fuel oils to meet consumer requirements. The refinery output of fuel oils in 1936 was 411,338,000 barrels compared with 360,061,000 in 1935, a gain of 14 percent. The above figures include fuel oil produced by cracking, totaling 225,857,000 barrels in 1936 and 194,734,000 in 1935. This is the third consecutive year in which fuel oil from cracking stills has exceeded the quantity obtained from straight-run refinery operations. In providing this larger amount of fuel oil in 1936, crude runs to stills were augmented by 11 percent, or from 965,790,000 barrels in 1935 to 1,068,134,000 in 1936. The crude runs yielded 125,650,000 barrels of gas oil and distillate fuel oil, a gain of 25 percent over the 1935 total of 100,235,000 barrels, and the production of residual fuel oil was higher by 10 percent, totaling 285,688,000 barrels in 1936 compared with 259,826,000 in 1935. The increase in percentage yield of gas oil and distillate fuel oils from 10.4 percent in 1935 to 11.8 percent in 1936 indicates a readjustment of refinery runs to meet the heavy demand for heating oils. The percentage yield of residual fuel oils changed but slightly, showing 26.9 percent in 1935 and 26.7 in 1936.

Calculations from known factors show an indicated domestic demand for fuel oils of 408,991,000 barrels in 1936, including 15,732,000 barrels of crude oil transferred to fuel oil in California. This was an increase of 12 percent over the 1935 indicated domestic demand of 366,723,000 barrels, including 13,067,000 barrels of crude oil transferred to fuel oil in California. The distribution of the 1936 demand by principal consumers is only partly known at present. Records compiled by the Interstate Commerce Commission show that class 1 railroads, in 1936 purchased 60,216,000 barrels of fuel oil, including Diesel oil, compared with 54,323,000 barrels in 1935. According to the Federal Power Commission, public-utility power plants required 14,119,000 barrels of fuel oil in 1936, a gain of 24 percent over the 1935 total of 11,393,000 barrels. Slightly less bunker oil was required by vessels engaged in coastwise trade in 1936. This loss, however, was more than made up by the bunker oil demand of vessels in the foreign trade, which increased sufficiently to give a net gain of 1,689,000 barrels in the 1936 bunker-oil loadings.

After the known items of demand in 1936 are deducted, a balance is left to supply all other fuel-oil needs, that totals 277,617,000 barrels compared with a balance of 245,657,000 barrels in 1935. Heating oils consumed in 1936 probably represented one-third of the 1936 quantity, and the difference was available for other major users, such as manufacturing industries, oil companies (field and plant use), the gas- manufacturing industry, the United States Navy, and other Government departments. These other demands, of which the respective volumes are unknown at present, comprise over 75 percent of the increased or new consumption in 1936 (31,960,000 barrels of a gain of 42,268,000 barrels of new demand in 1936). Indications point to a large increase in the use of heating oils in 1936, but the extent of the gain by other major users cannot be gaged at this time.

Imports of fuel oil and gas oil into Continental United States totaled 19,135,000 barrels in 1936 compared with 16,130,000 in 1935. Most

[2] By A. T. Coumbe, Petroleum Economics Division, Bureau of Mines.

of this foreign fuel oil is credited to the Netherland West Indies, with Mexico and Canada as secondary sources of supply. The import trade is confined largely to bunker oil received in bond for the supply of vessels, with New York the principal port of entry. Bunker oil received under this classification totaled 17,005,000 barrels in 1936, a gain of 5,232,000 barrels over 1935.

Exports of fuel oil and gas oil and shipments to noncontiguous territories, which totaled about 29,000,000 barrels for both 1934 and 1935, showed a gain of 18 percent in 1936 when 34,280,000 barrels were shipped out of the country. This is still well below the peak of 47,384,000 barrels of fuel oil exported in 1927. The 1936 gain over 1935 is shown in both light and heavy fuel oils. Gas oil and distillate fuel oils exported and shipped to noncontiguous territories totaled 19,884,000 barrels in 1936 compared with 16,249,000 barrels in 1935; and exports of residual fuel oils totaled 14,396,000 barrels in 1936, a gain of 1,697,000 barrels. Exports of fuel oil and gas oil to Japan, the principal foreign buyer, decreased slightly in 1936, when the total was 9,256,000 barrels compared with 9,292,000 in 1935. The gain in exports of fuel oil and gas oil must be credited largely to such European countries as Germany (2,841,000 barrels in 1936 compared with 843,000 in 1935), Netherlands (1,741,000 barrels in 1936 compared with 1,010,000 in 1935), and Italy (1,689,000 barrels in 1936 compared with 949,000 in 1935).

Fuel-oil stocks, which have declined since 1929, rose in 1936. Total stocks of fuel oil increased from 103,984,000 barrels at the end of 1935 to 106,918,000 at the end of 1936. Virtually all of this gain was in the gas oil and distillate fuel oils, stocks of which increased 2,789,000 barrels out of a total gain of 2,934,000 barrels. This accumulation of light fuel-oil stocks was centered mostly in California, where the increase was 1,983,000 barrels compared with 806,000 barrels in all other parts of the country. Heavy or residual fuel oils held in storage in California also increased noticeably, showing a gain of 4,254,000 barrels during 1936. The demand for heavy fuel oils in the other sections of the country was so pronounced that it was necessary to draw 4,109,000 barrels from storage, so that the net build-up in residual fuel oils for the country as a whole was only 145,000 barrels.

Fuel-oil prices in 1936 trended slightly upward. A weighted average price for 1936, compiled by Joseph E. Pogue, is $0.918 compared with $0.892 in 1935. Bunker C fuel oil at New York was advanced three times during the year due to the pressure of an almost record demand coupled with a tightening of the available supply and higher charter rates. On January 1 the New York price of Bunker C was increased by 10 cents to $1.05 per barrel, and the same relative increase was put into effect at all other Atlantic and Gulf ports. A 5-cent increase effective August 17 brought the New York Bunker C price to $1.10 per barrel, and a similar advance was made at most ports north of Charleston, S. C. Diminishing stocks of heavy oils in the eastern area of the country, brought about by continued heavy demand, forced still another general 5-cent-per-barrel increase effective October 1. The New York price for Bunker C was raised to $1.15 per barrel, and a like advance was posted at other Atlantic ports. Ample supplies of heavy fuel oil in the Pacific area helped to prevent much of a price increase. However, Bunker C at Los Angeles was slightly higher in 1936, averaging $0.9227 per barrel compared with $0.8993 in 1935.

A strong demand for light fuel oils was met by an ample supply, so that price increases were not as pronounced as with the heavier grades. An example is no. 2 straw distillate fuel oil, which averaged 3.1174 cents per gallon in 1936 compared with 3.0229 cents in 1935 at Oklahoma refineries.

Salient statistics of fuel oil in the United States, 1935–36

[Thousands of barrels of 42 gallons]

	1935			1936 [1]		
	Gas oil and distillate fuel oil	Residual fuel oil	Total	Gas oil and distillate fuel oil	Residual fuel oil	Total
Stocks at beginning of year	21,957	88,440	110,397	19,930	84,054	103,984
Production	100,235	259,826	[2] 360,061	125,650	285,688	[2] 411,338
Transfers from crude oil to residual fuel oil in California		13,067	13,067		15,732	15,732
Imports:						
Bonded		11,773	11,773	451	17,005	17,456
Duty paid	15	4,342	4,357	34	1,645	1,679
Exports	16,249	12,699	28,948	19,884	14,396	34,280
Stocks, end of year	19,930	84,054	103,984	22,719	84,199	106,918
Indicated domestic demand	86,028	280,695	366,723	103,462	305,529	408,991
Class I railroads—purchases [3]			54,323			60,216
Public-utility power plants [4]			11,393			14,119
Bunker oil, foreign trade			29,229			31,643
Bunker oil, coastwise trade			26,121			25,396
All other demands			245,657			277,617

[1] Preliminary.
[2] Includes production by cracking: 1934, 178,876; 1935, 194,734; 1936, 225,857.
[3] Interstate Commerce Commission.
[4] Federal Power Commission.

The following tables show pertinent statistics covering the distribution of gas-oil and fuel-oil sales, by major uses and by States, in the order of importance for the years 1930–35. A study of the items covering the distribution by uses brings out the fact that the low point in demand by various classes of consumers was reached in different depression years, ranging from 1931 for heating oils to 1934 for ships' bunkers and U. S. Naval use. The demand for heating oils has advanced steadily since 1931 and in 1935 became the principal item displacing bunker oil for the first time. The fuel-oil requirements of manufacturing industries have gained steadily since 1932, so that in 1935 the total of 61,128,000 barrels approached the peak demand of 63,431,000 barrels recorded in 1929.

The table covering the sales of gas oil and fuel oil by States, in order of importance, for the years 1930–35, shows California as the most important consumer with a 1935 total of 70,631,000 barrels, a quantity equal to about one-fifth of the national demand and almost equal to the combined demand of Texas and New York, which rank second and third in importance as fuel-oil markets. After California and Texas, where railroad, ships' bunkers, and oil-company use are largely responsible for the volume of demand, the fuel-oil market shifts to the north Atlantic seaboard to the densely populated States of New York, New Jersey, Pennsylvania, and Massachusetts, where the demand for heating oils, ships' bunkers, industrial power, and oil-refinery fuel build up impressive totals in fuel-oil consumption. The fuel-oil demand of Illinois, next in importance among the States, is attributed largely to the requirements for heating oil.

Sales of gas oil and fuel oil,[1] *1930–35, by uses*

[Thousands of barrels of 42 gallons]

Use	1930	1931	1932 [2]	1933 [2]	1934	1935
Railroads	67, 900	58, 150	48, 908	48, 305	52, 581	55, 651
Ships' bunkers (including tankers)	94, 152	83, 559	72, 531	70, 445	69, 262	74, 581
Gas and electric power plants	26, 769	24, 490	22, 199	22, 507	23, 143	23, 647
Smelters and mines	6, 841	4, 363	[3] 2, 130	[3] 2, 538	[3] 2, 682	2, 448
Manufacturing industries	53, 921	46, 873	[3] 46, 370	[3] 48, 962	[3] 54, 260	61, 128
Heating oils	43, 279	40, 578	44, 264	50, 140	60, 822	76, 853
U. S. Navy, Army transports, etc	8, 681	9, 203	7, 968	8, 000	7, 914	10, 428
Oil-company fuel	55, 943	52, 710	47, 700	46, 200	47, 404	48, 116
Miscellaneous uses	9, 875	9, 211	9, 500	11, 250	12, 253	13, 133
Total United States	367, 361	329, 137	301, 570	308, 347	330, 321	365, 985
Exports and shipments	36, 450	29, 231	19, 994	20, 563	28, 605	28, 948
	403, 811	358, 368	321, 564	328, 910	358, 926	394, 933
Range oil	[4] 3, 000	4, 549	6, 841	10, 269	15, 756	21, 526

[1] Includes some crude oil burned as fuel.
[2] Partly estimated.
[3] Revised figures.
[4] Estimated.

Domestic sales of gas oil and fuel oil,[1] *1930–35, by States*

[Thousands of barrels of 42 gallons]

	1930	1931	1932 [2]	1933 [2]	1934	1935
California	83, 049	68, 401	59, 141	59, 893	63, 801	70, 631
Texas	49, 710	46, 423	41, 910	38, 696	38, 368	39, 382
New York	29, 529	27, 415	26, 865	28, 097	30, 367	36, 087
New Jersey	35, 084	33, 402	29, 022	30, 193	30, 646	32, 554
Pennsylvania	19, 832	20, 591	19, 190	19, 751	21, 871	23, 452
Massachusetts	13, 057	13, 002	13, 041	12, 786	14, 394	17, 187
Illinois	14, 565	13, 014	11, 820	11, 861	13, 206	15, 037
Louisiana	14, 906	12, 171	9, 134	8, 663	8, 585	10, 481
Oklahoma	12, 948	9, 390	9, 316	9, 698	9, 836	9, 581
Washington	10, 376	7, 974	7, 517	8, 312	8, 485	8, 976
Michigan	4, 232	4, 252	4, 966	5, 723	7, 631	8, 634
Maryland	5, 901	5, 825	6, 095	6, 217	7, 053	7, 715
Kansas	4, 778	5, 539	6, 020	5, 924	6, 693	7, 394
Florida	7, 004	5, 903	5, 495	6, 035	7, 310	7, 387
Indiana	6, 084	5, 894	5, 944	6, 264	6, 199	6, 935
Rhode Island	5, 009	4, 017	4, 525	5, 591	6, 412	6, 591
Missouri	5, 739	5, 484	5, 070	5, 098	5, 456	6, 583
Oregon	7, 249	6, 615	4, 869	5, 430	6, 079	6, 564
Ohio	4, 737	4, 811	5, 262	5, 381	5, 393	5, 826
Connecticut	3, 047	2, 527	2, 977	3, 692	4, 862	5, 742
Other States	30, 525	26, 487	23, 391	25, 042	27, 674	33, 246
Total United States	367, 361	329, 137	301, 570	308, 347	330, 321	365, 985

[1] Includes some crude oil burned as fuel.
[2] Partly estimated.

The tabulation given below shows the distribution of fuel-oil sales, by States, between light and heavy grades or between (1) gas oil and distillate fuel oil and (2) residual fuel oil for the years 1934 and 1935. Sales of range oil, by States, for the same years also are indicated.

Sales of gas oil, distillate fuel oil, residual fuel oil,[1] and range oil, by States, 1934–35

[Thousands of barrels of 42 gallons]

	1934				1935			
	Gas oil and distillate fuel oil	Residual fuel oil	Total gas oil and fuel oil	Range oil	Gas oil and distillate fuel oil	Residual fuel oil	Total gas oil and fuel oil	Range oil
California	10,568	53,233	63,801	398	10,700	59,931	70,631	426
Oregon	574	5,505	6,079	18	686	5,878	6,564	38
Washington	1,561	6,924	8,485	11	1,878	7,098	8,976	43
Arizona	175	554	729	23	225	990	1,215	28
Nevada	141	523	664	9	183	534	717	13
Idaho	23	59	82	-------	30	110	140	4
Montana	190	1,031	1,221	5	201	1,475	1,676	7
Wyoming	122	1,142	1,264	2	144	1,274	1,418	3
Utah	34	220	254	17	44	216	260	22
Colorado	115	285	400	19	143	321	464	19
New Mexico	120	633	753	-------	149	686	835	12
North Dakota	168	31	199	37	218	51	269	44
South Dakota	209	144	353	57	269	205	474	61
Minnesota	1,603	1,193	2,796	311	1,848	1,138	2,986	209
Nebraska	647	505	1,152	33	773	542	1,315	81
Iowa	757	275	1,032	66	1,009	369	1,378	152
Missouri	1,781	3,675	5,456	44	2,447	4,136	6,583	232
Kansas	701	5,992	6,693	118	922	6,472	7,394	186
Wisconsin	1,023	1,392	2,415	76	1,521	1,471	2,992	153
Illinois	5,534	7,672	13,206	75	6,044	8,993	15,037	305
Indiana	964	5,235	6,199	21	1,288	5,647	6,935	60
Michigan	1,795	5,836	7,631	139	2,245	6,389	8,634	179
Ohio	1,047	4,346	5,393	109	1,156	4,670	5,826	182
Kentucky	133	616	749	2	173	642	815	20
Tennessee	120	380	500	25	149	179	328	76
Texas	5,276	33,092	38,368	53	6,370	33,012	39,382	169
Oklahoma	936	8,900	9,836	1	1,374	8,207	9,581	78
Arkansas	370	1,975	2,345	-------	465	2,079	2,544	96
Louisiana	1,241	7,344	8,585	71	1,609	8,872	10,481	90
Mississippi	64	201	265	21	97	379	476	61
Alabama	98	1,076	1,174	23	113	1,181	1,294	25
Maine	485	1,002	1,487	677	691	1,065	1,756	800
New Hampshire	646	239	885	489	775	401	1,176	561
Vermont	105	248	353	278	224	169	393	389
Massachusetts	5,159	9,235	14,394	5,654	5,933	11,254	17,187	7,203
Rhode Island	1,568	4,844	6,412	1,161	1,624	4,967	6,591	1,354
Connecticut	1,565	3,297	4,862	1,653	1,993	3,749	5,742	2,223
New York	10,980	19,387	30,367	2,691	12,267	23,820	36,087	3,322
New Jersey	6,139	24,507	30,646	979	6,926	25,628	32,554	1,200
Pennsylvania	5,043	16,828	21,871	167	5,278	18,174	23,452	299
Delaware	208	657	865	-------	238	676	914	57
Maryland	1,594	5,459	7,053	25	1,879	5,836	7,715	394
District of Columbia	695	495	1,190	7	1,047	462	1,509	36
Virginia	549	1,259	1,808	75	721	1,854	2,575	162
West Virginia	98	478	576	17	168	751	919	31
North Carolina	180	154	334	8	205	197	402	238
South Carolina	98	451	549	7	144	365	509	47
Georgia	282	998	1,280	28	331	1,166	1,497	93
Florida	1,232	6,078	7,310	56	1,472	5,915	7,387	143
Total United States	74,716	255,605	330,321	15,756	86,389	279,596	365,985	21,526

[1] Includes some crude oil burned as fuel.

LUBRICANTS

The domestic demand for lubricants, which was seriously depressed from 1932 through 1935, recovered substantially in 1936. The total demand during the year was 3,015,000 barrels greater than in 1935 and amounted to 22,676,000 barrels, a figure exceeded only in 1928 and 1929. The demand reached a peak of 23,609,000 barrels in 1929. It is estimated that 13,760,000 barrels of the demand in 1936 were used by motor vehicles and 8,916,000 barrels for industrial purposes. The following is the estimated division of the demand for lubricants into motor-vehicle and industrial uses.

153336—37——67

Domestic demand for lubricating oil, 1929–36

[Thousands of barrels of 42 gallons]

Year	Consumption by motor vehicles	By industries	Total domestic demand	Year	Consumption by motor vehicles	By industries	Total domestic demand
1929	13,429	10,180	23,609	1933	11,781	5,371	17,152
1930	13,614	7,975	21,589	1934	12,337	6,087	18,424
1931	13,447	6,621	20,068	1935	12,722	6,939	19,661
1932	12,061	4,553	16,614	1936	13,760	8,916	22,676

Exports of lubricants, amounting to 8,315,000 barrels, were slightly less than the 1935 figure of 8,499,000 barrels.

Stocks of lubricants on hand December 31,1936, totaled 6,942,000 barrels, compared with 7,025,000 on the same date in 1935. As usual, the East Coast district, with 2,151,000 barrels, compared with 2,227,-000 barrels at the end of 1935, had the largest stocks. Gulf Texas ranked second, having 1,350,000 barrels, compared with 1,553,000 barrels in 1935. The figures for both these districts represent the lowest points in long downward trends. The figure for California—1,055,000 barrels, compared with 975,000 barrels in 1935—represents the highest stocks since December 31,1930. The stocks in the first two districts have dropped from 54 percent of the total at the end of 1935 to 50 percent at the end of 1936, and California's proportion has risen from 14 to 15 percent during this same period.

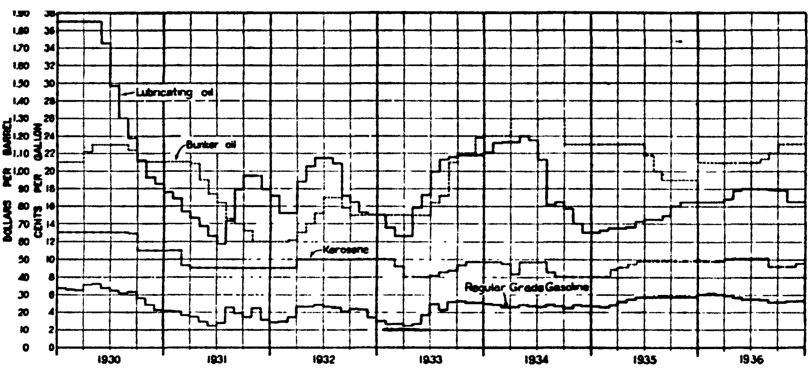


FIGURE 74.—Trends in prices of refined petroleum products, 1930–36, by months.

Price trends for lubricating oils were not consistent for the various grades in the different parts of the country. Refinery prices for bright stocks in Oklahoma, after showing a 1½-cent increase during the summer, relapsed in November to the price in effect early in the year. Prices for pale neutrals in the Midcontinent field, after holding steady through most of the year, dropped 3¾ cents in October and had recovered only 1 cent of this drop by the end of the year. Pennsylvania grades of neutrals, after displaying weakness throughout the year, were about the same or slightly higher in December than in January; Pennsylvania bright stocks gained about 2½ cents during the summer and closed the year 1½ cents higher than in the beginning of the year; and other cylinder stocks gained about 3½ cents during the year.

OTHER PRODUCTS

WAX

The production of paraffin wax amounted to 472,920,000 pounds in 1936 compared with 450,240,000 pounds in 1935. Domestic demand also increased to 301,488,000 pounds from 261,353,000 pounds in 1935, and exports declined to 187,342,000 pounds in 1936 from 229,905,000 pounds in 1935. Imports declined from 19,557,000 pounds in 1935 to 16,669,000 pounds in 1936. Stocks increased slightly to 115,434,000 pounds on December 31, 1936.

The average price in New York for yellow crude scale wax for domestic shipment recovered only slightly from the 1935 decline, the average being 2.4 cents per pound, compared with an average of 2.2 cents in 1935.

COKE

Domestic demand for petroleum coke declined to 1,253,400 short tons in 1936 from 1,340,700 in 1935. Exports declined to 124,300 short tons in 1936 from 133,500 in 1935.

ASPHALT AND ROAD OIL

The domestic demand for petroleum asphalt increased sharply in 1936, amounting to 4,033,400 short tons, compared with 2,845,800 in 1935. Details for asphalt and road oil may be found in the chapter on Asphalt and Related Bitumens.

STILL GAS

The production of still or refinery gas totaled 207,535 million cubic feet in 1936, compared with 197,220 million in 1935.

WORLD PRODUCTION AND FOREIGN TRADE[4]

The upward trend in world production of petroleum, first evidenced in the increase in the total for 1933, was continued in 1936, when 1,790,271,000 barrels were produced, compared with 1,654,593,000 in 1935. The largest single factor in the gain of 136,000,000 barrels in world output was the gain of 102,000,000 barrels in the United States. The share of the United States, which fell just under 60 percent in 1934, rose to 60.2 percent in 1935 and to 61.4 percent in 1936.

All the leading producing countries showed gains in 1936, and no important changes in rank occurred. The largest relative gain for any country was registered by Bahrein Island, which produced 4,645,000 barrels, compared with 1,265,000 in 1935.

Data on oil-shale production for 1936 are lacking except for Estonia, whose output apparently showed a material increase over 1935. The 1935 data show Scotland producing more oil shale than all other countries combined, but production in the U. S. S. R. (Russia) was expanding rapidly. No commercial production in the United States has been reported since 1929.

[4] By A. H. Redfield, Petroleum Economics Division, U. S. Bureau of Mines.

World production of petroleum, 1932–36, by countries, in thousands of barrels

[Compiled by R. B. Miller]

Country	1932	1933	1934	1935	1936 [1]
United States	785, 159	905, 656	908, 065	996, 596	1, 098, 516
U. S. S. R. (Russia) [2]	154, 775	153, 382	174, 986	182, 386	189, 941
Venezuela	116, 541	117, 720	136, 103	148, 529	155, 229
Rumania	53, 815	54, 020	62, 063	61, 371	63, 750
Iran	49, 471	54, 392	57, 851	57, 304	61, 728
Netherland India	39, 001	42, 667	46, 925	47, 171	[3] 49, 360
Mexico	32, 805	34, 001	38, 172	40, 241	41, 028
Iraq	836	917	7, 689	27, 311	29, 406
Colombia	16, 414	13, 158	17, 341	17, 598	18, 756
Peru	9, 889	13, 257	16, 314	17, 067	17, 595
Argentina	13, 139	13, 691	14, 024	14, 295	15, 455
Trinidad	10, 126	9, 561	10, 894	11, 671	13, 237
India, British	8, 817	8, 743	10, 503	9, 218	9, 619
British Borneo (Sarawak and Brunei)	3, 796	4, 490	5, 140	5, 389	4, 720
Bahrein Island	----------	31	285	1, 265	4, 645
Poland	4, 116	4, 072	3, 913	3, 812	3, 777
Germany	1, 608	1, 665	2, 187	2, 967	3, 087
Sakhalin	2, 854	2, 630	2, 798	2, 545	2, 218
Japan (including Taiwan)	1, 630	1, 455	1, 821	2, 250	2, 445
Ecuador	1, 597	1, 620	1, 637	1, 732	1, 951
Canada	1, 044	1, 145	1, 417	1, 447	1, 498
Egypt	1, 895	1, 663	1, 546	1, 295	1, 223
France	530	562	557	539	535
Other countries	440	509	585	594	552
Total	1, 310, 298	1, 441, 007	1, 522, 816	1, 654, 593	1, 790, 271

[1] Preliminary.
[2] Exclusive of Sakhalin.
[3] Approximate production.

World production of oil shale, 1932–36, in metric tons

[Compiled by M. T. Latus]

Country	1932	1933	1934	1935	1936
Australia:					
New South Wales	2, 734	----------	203	----------	(1)
Tasmania	1, 115	3, 456	3, 329	37	(1)
China (Manchuria)	1, 412, 558	(1)	(1)	(1)	(1)
Estonia	495, 811	499, 969	588, 958	604, 288	766, 41
France [2]	91, 400	91, 000	102, 340	88, 473	(1)
Germany (Bavaria)	401	553	869	(1)	(1)
Italy	1, 268	918	550	(1)	(1)
Spain	64, 132	60, 448	37, 783	(1)	(1)
U. S. S. R. (Russia)	318, 200	201, 600	206, 400	417, 000	(1)
United Kingdom: Scotland	1, 390, 562	1, 419, 410	1, 423, 257	1, 430, 976	(1)

[1] Data not available. [2] Includes some boghead coal.

IMPORTS, EXPORTS, AND SHIPMENTS THROUGH PANAMA CANAL

The tendencies in the foreign trade of the United States in mineral oils that have been manifested since the middle of 1932 continued in 1936. Although both imports and exports of mineral oils increased in quantity from 1933 to 1936, their relationship to the total demand, domestic and foreign, has remained virtually unaltered. A change in the fiscal policy of the United States reduced both the quantity of mineral oils imported since the middle of 1932 and their proportion of the national supply. Increased production of crude petroleum in other countries has decreased both the quantity and the proportion of all oils exported since 1930, and the growth of refining in other countries has effected a sharp increase in exports of crude petroleum at the expense especially of the lighter refined products.

Imports of petroleum and its products (including wax, petrolatum, and asphalt) into continental United States increased from 52,782,000

barrels in 1935 to 57,250,000 in 1936, according to statistics obtained from the Bureau of Foreign and Domestic Commerce. In 1936 dutiable imports of mineral oils for direct consumption totaled 36,228,000 barrels, compared with 33,596,000 in 1935. Imports in bond, primarily for supplies of vessels and secondarily for refining and export, amounted to 21,022,000 barrels in 1936, compared with 19,187,000 in 1935.

The proportionate increase in imports of petroleum, both dutiable and bonded, from 1935 to 1936 was 8 percent, compared with an increase of 10 percent in total demand, domestic and foreign, over the same period. In terms of daily demand, domestic and foreign, the total imports in 1935 amounted to 17.3 days' supply and in 1936 to 17.1 days' supply. Imports of petroleum and petroleum products constituted about 5 percent of the total national demand for mineral oils, domestic and foreign, in both 1935 and 1936.

As a result of higher excise taxes levied on imported gasoline and lubricating oil, 99.3 percent of the total imports in 1935 and 98.7 percent in 1936 consisted of crude petroleum, fuel oil, and unfinished distillates. Such finished light oils as were imported went chiefly to Puerto Rico and the Virgin Islands.

Increases in imports of dutiable crude petroleum, chiefly heavy crudes from Mexico and Venezuela for the manufacture of asphalt, of fuel oil in bond for the supplies of vessels, and of unfinished oils for further refining were offset in part by decreases in imports of fuel oil into Atlantic coast and Gulf coast ports for domestic consumption.

Crude petroleum imported into and exported from continental United States, 1930–36 [1]

[Millions of barrels of 42 gallons]

	1930	1931	1932	1933	1934	1935	1936
Imports:							
By countries:							
Venezuela [2]	35.1	25.2	25.6	17.1	25.4	25.0	28.4
Colombia	14.2	12.3	10.6	7.7	4.2	3.8	
Mexico	10.1	8.2	7.1	5.9	5.9	3.4	4.5
All other	2.7	1.6	1.4	1.2	.1	.1	.1
	62.1	47.3	44.7	31.9	35.6	32.3	33.0
Exports:							
By countries:							
Canada	19.0	19.2	18.1	19.5	22.0	24.4	25.7
Japan	2.9	3.6	4.9	5.5	6.7	10.5	10.4
France		.6	3.4	9.1	10.2	10.3	7.5
All other	1.8	2.1	1.0	2.5	2.2	6.2	6.7
	23.7	25.5	27.4	36.6	41.1	51.4	50.3
Net imports	38.4	21.8	17.3				
Net exports				4.7	5.5	19.1	17.3

[1] Data from Bureau of Foreign and Domestic Commerce.
[2] Includes imports via Netherland West Indies.

Imports of crude petroleum, both dutiable and bonded, increased 2 percent over 1935 in 1936. Their daily average of 90,000 barrels in 1936 did not exceed the daily average of 91,000 barrels for the 4 years 1933–36 and was less than half of the daily average of 183,000 barrels of crude petroleum imported during the 4 years 1928–31 before excise taxes in the Revenue Act of 1932 were adopted. More than nine-tenths of the foreign crude petroleum received in 1936 consisted of heavy Venezuelan and Mexican crudes imported, duty paid, primarily

for the manufacture of asphalt and road oil. Included in the total imports, however, were 2,391,567 barrels of lighter crude from Venezuela entered for refining in bond and export of the manufactured products. Colombia, which shipped to the United States 13,000,000 barrels a year of 29°–30° crude from 1929 to 1931, supplied only 71,590 barrels in 1936, all for refining in bond and export of the finished products.

Entries of fuel oil into bond, primarily for supplies of vessels, increased from 12,954,000 barrels in 1935 to 18,016,000 in 1936. Included in these totals were 736,000 barrels in 1935 and 852,000 entered into bond in Puerto Rico. The Netherland West Indies supplied 14,676,000 barrels of the fuel oil entered into bond in 1936, Mexico 3,266,000 barrels, and Canada 74,000 barrels. Of the 17,164,000 barrels of fuel oil entered into bond in continental United States in 1936, 16,440,000 barrels were withdrawn from bond for supplies of vessels, 13,000 barrels exported, 164,000 barrels withdrawn from bond for domestic consumption on payment of duty, and 547,000 barrels added to storage. Bonded stocks of fuel oil in continental United States on December 31, 1936, totaled 1,647,000 barrels.

Direct imports of fuel oil and topped petroleum into continental United States for domestic consumption decreased from 7,691,000 barrels in 1935 to 5,336,000 in 1936. To these amounts were added 307,000 barrels of fuel oil withdrawn from bond for domestic consumption on payment of duty in 1935, and 164,000 barrels similarly withdrawn in 1936.

Ninety-three percent of the fuel oil and topped crude, dutiable and in bond, imported into continental United States in 1935 and 94 percent in 1936 went to Atlantic coast ports, and 6 percent in both 1935 and 1936 went to Gulf coast ports.

Imports of paraffin wax listed in the accompanying table included 409,000 pounds in 1935 and 1,022,000 in 1936 entered into bond primarily for reexport.

Imports and exports of petroleum products, 1935–36 [1]

	1935	1936
Imports:		
Crude petroleum .... thousands of barrels..	32,330	32,957
Gasoline .... do....	9	
Fuel oil, including topped crude .... do....	19,909	22,500
Gas oil and Diesel oil .... do....		608
Lubricants .... do....	2	5
Wax .... thousands of pounds..	19,699	16,669
Petroleum jelly, petrolatum, etc .... do....		82
Asphalt .... thousands of short tons..	54.0	21.6
Unfinished oils .... thousands of barrels..	165	
Other petroleum distillates .... do....		
Exports: [2]		
Crude petroleum .... do....	51,430	50,313
Motor fuel .... do....	30,613	28,544
Kerosene .... do....	6,651	6,932
Gas oil and distillate fuel oil .... do....	16,249	19,906
Residual fuel oil .... do....	12,699	14,411
Lubricants .... do....	8,499	[illegible]
Wax .... thousands of pounds..	229,905	187,341
Petroleum coke .... thousands of short tons..	133.5	124.6
Petroleum asphalt .... do....	232.8	211.4
Mineral spirits .... thousands of barrels..	76	71

[1] Bureau of Foreign and Domestic Commerce.
[2] Includes shipments to Alaska, Hawaii, Puerto Rico, and the Virgin Islands.

At the same time, exports of petroleum, crude and refined, from continental United States and shipments of mineral oils to the noncontiguous territories increased 2 percent—from 128,987,000 barrels in 1935 to 131,245,000 in 1936. These exports and Territorial shipments consituted 12 percent of the total demand for all oils, domestic and foreign, in 1935 and 11 percent in 1936.

The principal increases were in exports and Territorial shipments of gas oil and distillate fuel oil, due primarily to the growing use of Diesel-type engines. Smaller increases were shown in exports and shipments of residual fuel oil, lubricating oils, and kerosene. On the other hand, exports and shipments of gasoline and light fractions of petroleum were somewhat less in 1936 than in 1935, owing chiefly to increased refining activity in Europe, the Netherland West Indies, Canada, Iran, and Japan.

Two-fifths of the exports and Territorial shipments of mineral oils from the United States in 1935 and 1936 consisted of crude petroleum. These decreased slightly—from 51,430,000 barrels in 1935 to 50,313,000 in 1936. In both years nearly nine-tenths of the total shipments were made to three countries. Exports of crude petroleum to France declined from 10,348,000 barrels in 1935 to 7,463,000 in 1936 as a result of greater receipts by French refineries from Iraq, Rumania, Peru, and Venezuela. Exports to Japan were slightly less—10,483,000 barrels in 1935 and 10,394,000 in 1936. Canada, however, increased its purchases of American crude from 24,412,000 barrels in 1935 to 25,683,000 in 1936. Increased shipments of crude to Italy, Argentina, Cuba, Sweden, the Netherlands, and the Union of South Africa aided in offsetting the decline in shipments to France, Germany, and the United Kingdom.

Of the major refined oils, exports and Territorial shipments of motor fuels and of naphtha declined 9 percent—from 30,613,000 barrels in 1935 to 28,544,000 in 1936. These totals included 349,000 barrels of benzol in 1935 and 456,000 in 1936. The greatest decreases were in sales to the United Kingdom, which reduced its purchases from 5,883,000 barrels in 1935 to 4,665,000 in 1936 buying more from the Netherland West Indies, Rumania, and Trinidad in 1936; to France, which decreased its purchases from 2,413,000 barrels in 1935 to 867,000 in 1936 and increased at the same time its receipts from Rumania, Iran, and the Netherland West Indies. Similarly, exports of light petroleum products to Australia, Belgium, Canada, the Philippine Islands, Hawaii, and to Sweden were less in 1936 than in 1935. On the other hand, exports of gasoline and naphtha to the minor foreign consumers increased from 1935 to 1936, but not sufficiently to arrest the decline in shipments to the major purchasers.

Exports and Territorial shipments of kerosene from the United States increased 4 percent from 1935 to 1936. Although shipments to the Netherland West Indies, the United Kingdom, the Netherlands, the Philippine Islands, Sweden, Finland, Panama, and Hawaii increased, exports to Brazil, China, Australia, Portugal, and Norway were less in 1936 than in 1935.

The greatest increase was in exports and Territorial shipments of gas oil and distillate fuel oil—from 16,249,000 barrels in 1935 to 19,906,000 in 1936. The principal gains occurred in shipments to Germany, which has especially fostered the use of the Diesel-type engine, the Netherlands, the Netherland West Indies, Belgium, Spain, and Greece. On the other hand, less gas oil and distillate fuel

oil was sold to Japan, which increased its refinery output, and to the United Kingdom, which bought more from Rumania.

Although international shipping continued to revive, competition of the Netherland West Indies, Mexico, Trinidad, Rumania, Iran, and Netherland India was responsible for the smaller increase in American exports and Territorial shipments of residual fuel oil—from 12,699,000 barrels in 1935 to 14,411,000 in 1936. Increased sales to Japan, Chile, Canada, Italy, Panama, Spain, the Philippine Islands, and Greece, as well as to smaller purchasers, contributed to the general increase, in spite of smaller sales to Mexico, New Zealand, and some minor foreign consumers.

As a result of general economic recovery and of continued industrialization of the less-developed countries, exports and Territorial shipments of lubricating oils increased from 8,499,000 barrels in 1935 to 8,680,000 in 1936. The principal purchasers in 1936 were the United Kingdom, Germany, Belgium, France, British India, Canada, Australia, Japan, Italy, and China, which took, all together, more than three-fourths of the total exports.

Exports [1] of the major petroleum products, 1935–36 by countries of destination

[Thousands of barrels of 42 gallons, except wax, which is in thousands of pounds]

	Gasoline [2]		Kerosene		Gas oil and fuel oil		Lubricating oil		Wax	
	1935	1936	1935	1936	1935	1936	1935	1936	1935	1936
Argentina	18	155	1	1			60	39	4,691	6,130
Australia	2,233	1,877	278	181	5	113	416	354	454	814
Belgium	1,658	1,442	124	43	306	796	717	767	8,605	8,004
Brazil	1,144	1,157	524	501	44	51	229	207	2,388	2,271
British India	9		1	6	84		427	425	804	866
Canada	1,419	1,214	44	55	1,542	1,631	434	410	1,709	1,534
Chile	144	173		6	1,610	1,644	44	53	6,256	1,810
China, Hong Kong, and Kwantung	507	642	955	684	462	571	249	274	10,909	10,192
Colombia	10	12			1	2	12	15	4,640	7,143
Cuba	560	643	42	1	361	406	51	43	2,352	2,379
Denmark	16	183		4	138	271	196	166	2,255	1,693
Finland	58			110	34		5	7	733	726
France	2,413	867	1	2	66	104	532	479	662	395
Germany	744	657	6	1	843	2,841	591	1,271	17,093	9,959
Irish Free State	136	167	30	40	9	11	7	6	2,458	2,076
Italy	423	426	26	9	949	1,689	467	261	33,228	28,154
Japan	699	1,081	31		9,292	9,256	282	308	513	365
Mexico	209	189	21	25	1,088	900	62	68	3,370	2,063
Netherlands	928	789	526	693	1,010	1,741	158	319	9,344	5,863
Netherland West Indies	662	831	986	1,301	451	982	5	6	22	
New Zealand	549	562	24	15	859	736	68	49	279	37
Norway	234	60	128	97	293	257	44	35	1,332	753
Panama	192	225	37	109	1,877	1,821	11	10	293	177
Philippine Islands	1,079	917	451	513	758	865	71	68	3,142	1,345
Spain	2,113	2,056			455	1,252	73	28	3,216	584
Sweden	1,048	441	298	356	536	275	96	87	6,467	5,534
Union of South Africa	747	895	150	152	26	45	97	130	1,164	2,059
United Kingdom	5,883	4,665	757	937	1,471	1,360	1,856	2,058	69,090	55,604
Other countries	2,764	2,305	1,021	870	1,470	1,985	1,140	660	32,395	28,748
	28,599	24,631	6,462	6,712	26,040	31,605	8,400	8,603	229,864	187,278
SHIPMENTS TO NONCONTIGUOUS TERRITORIES										
Alaska	188	77	9	3	697	478	13	6		5
Puerto Rico	455	487	76	97	101	224	21	24	29	21
Virgin Islands	10	14	3	2	2	2	1	1		
Hawaii	1,045	1,170	107	130	2,138	2,031	67	49	15	37
	1,698	1,748	195	232	2,938	2,735	102	80	44	63

[1] Includes exports from noncontiguous territories.
[2] Includes natural gasoline.

Shipments through Panama Canal.—Shipments of mineral oils from California to the Atlantic coast through the Panama Canal decreased from 9,769,000 barrels in 1935 to 7,992,000 in 1936. The principal decrease was in shipments of gasoline, which formed 73 percent of the total shipments in 1935 and 1936. Lower tanker rates, averaging 39 percent of the rates from California to Atlantic ports, enabled Gulf coast refiners to supply gasoline to the east coast at 10 percent less than the delivered price quoted by California shippers and to increase gasoline shipments from the Gulf coast to the Atlantic seaboard from 141,193,000 barrels in 1935 to 153,026,000 in 1936. Similarly, kerosene shipments from California to the Atlantic coast declined from 1,189,000 barrels in 1935 to 1,133,000 in 1936 and intercoastal shipments of California gas oil and fuel oil from 877,000 barrels in 1935 to 625,000 in 1936.

NATURAL GAS [1]

By F. S. LOTT and G. R. HOPKINS [2]

SUMMARY OUTLINE

A vigorous growth in demand characterized the natural-gas industry in 1936, and gas sales increased to an all-time high. The continued expansion in industrial activity and increases in the purchasing power of consumers were instrumental in causing an unusually large expansion in markets for natural gas in 1936. The industry absorbed virtually all of its excess pipe-line capacity, which had accumulated as the result of the construction boom in the late twenties, and embarked upon another period of expansion. The present emphasis, however, appears to be on enlarging the capacity of existing major lines through looping and extensions rather than on the construction of new systems.

Marketed production for the year reached an estimated total of 2,175,000,000,000 cubic feet, an increase of 13 percent over that in 1935. This marks the first time that the annual volume has exceeded 2,000,000,000,000 cubic feet. The value of the production at the wells was $126,150,000, based upon the assumption that the average price was 5.8 cents per thousand cubic feet, as in 1935. (See fig. 75.) Imports from Canada were reported as 153,000,000 cubic feet and exports to that country as 85,000,000 cubic feet. Although final quantity data on exports to Mexico are not yet available, the total was about 7,400,000,000 cubic feet in 1936, compared with 6,727,000,000 cubic feet in 1935. Deducting the excess of exports over imports

[1] Data for 1936 are preliminary; detailed statistics with final revisions will be released later.
[2] Tables compiled by H. Backus, Petroleum Economics Division, U. S. Bureau of Mines.

from the total marketed production indicates that the consumption of natural gas in the United States in 1936 was 2,167,668,000,000 cubic feet. The total value of domestic sales at points of consumption in 1936 was about $479,000,000, an average of 22.1 cents per thousand cubic feet. This represents a decline of 0.3 cent from the average value in 1935. The decline in value of natural gas probably reflects a slightly lower average price for domestic and commercial consumption and a relatively greater increase in sales of low-priced gas for industrial purposes.

Summary of statistics for natural gas in the United States, 1931–36

	1931	1932	1933	1934	1935	1936 [1]
Marketed production millions of cubic feet						
California do	305,930	263,484	259,799	268,122	284,109	325,000
Louisiana do	224,155	201,561	197,826	225,713	249,450	293,000
Oklahoma do	263,685	255,487	245,759	254,457	274,313	305,000
Texas do	464,580	456,832	475,691	602,976	642,366	725,000
West Virginia do	124,797	100,540	100,653	109,161	115,772	130,000
Other States do	303,289	278,086	275,746	310,292	350,585	397,000
Total production do	1,686,436	1,555,990	1,555,474	1,770,721	1,916,595	2,175,000
Exports:						
To Canada do	74	83	69	73	73	85
To Mexico do	2,157	1,610	2,089	5,728	6,727	7,400
Imports from Canada do	44	38	83	68	106	153
Consumption:						
Domestic do	294,406	298,520	283,197	288,236	313,498	345,000
Commercial do	86,491	87,367	85,577	91,261	100,187	113,000
Industrial:						
Field do	571,365	529,378	491,159	554,542	580,414	640,000
Carbon-black plants do	195,396	168,237	190,081	229,933	241,589	283,421
Petroleum refineries do	75,548	67,467	66,333	79,965	80,175	(2)
Electric public-utility power plants [3] millions of cubic feet	138,343	107,239	102,601	127,896	125,239	156,080
Portland-cement plants [4] do	31,381	21,440	22,001	27,331	26,752	36,923
Other industrial do	291,319	274,687	312,450	365,824	442,047	593,244
Total consumption do	1,684,249	1,554,335	1,553,399	1,764,988	1,909,901	2,167,668
Domestic percent	18	19	18	16	17	16
Commercial do	5	6	6	5	5	5
Industrial do	77	75	76	79	78	79
Number of consumers:						
Domestic thousands	6,443	6,506	6,691	6,984	7,391	(2)
Commercial do	518	531	541	582	613	(2)
Industrial [5] do	28	30	30	31	36	(2)
Number of producing gas wells	55,756	54,160	53,660	[6] 54,130	53,790	(2)
Value (at wells) of gas produced:						
Total thousands of dollars	117,505	98,985	97,096	106,438	110,402	126,150
Average per M cubic feet cents	7.0	6.4	6.2	6.0	5.8	5.8
Value (at point of consumption) of gas consumed:						
Total thousands of dollars	392,156	384,123	368,119	394,257	428,074	479,000
Domestic do	208,262	223,377	209,699	215,029	233,940	251,000
Commercial do	41,347	44,000	42,582	45,287	49,386	55,000
Industrial do	142,547	116,746	115,838	133,941	144,748	173,000
Average per M cubic feet:						
Domestic cents	70.7	74.8	74.0	74.6	74.6	72.8
Commercial do	47.8	50.4	49.8	49.6	49.3	48.7
Industrial do	10.9	10.0	9.8	9.7	9.7	10.1
Domestic and commercial do	65.5	69.3	68.4	68.6	68.5	66.8
Domestic, commercial, and industrial cents	23.3	24.7	23.7	22.3	22.4	22.1
Treated for natural gasoline:						
Quantity millions of cubic feet	1,790,119	1,499,756	1,551,464	1,776,172	1,822,000	1,900,000
Percent of total consumption	[7] 106	96	100	[7] 101	95	88

[1] Subject to revision.
[2] Figures not available.
[3] U. S. Geological Survey.
[4] Chapters on cement, in Minerals Yearbook and Statistical Appendix to Minerals Yearbook.
[5] Exclusive of oil- and gas-field operators.
[6] Revised figure.
[7] Exceeds 100 percent, as part of the natural gas treated for natural gasoline is blown to the air and not included in total consumption.

Of total domestic sales in 1936, 1,709,668,000,000 cubic feet was for industrial use; this was 15 percent more than the 1935 total of

1,496,216,000,000 cubic feet. Miscellaneous industrial demand, including petroleum refineries, increased approximately 13 percent, reflecting activity in the glass, ceramic, metal-working, and other industries. In some cities in the Middle West industrial demand increased more than 30 percent.

COMPETITIVE POSITION

The weighted average price of representative grades of fuel oil increased from 67 cents per barrel in 1933 to 92 cents per barrel in 1936. The average price of coal probably increased 33 percent from just before the code was inaugurated to the close of 1936. As the average

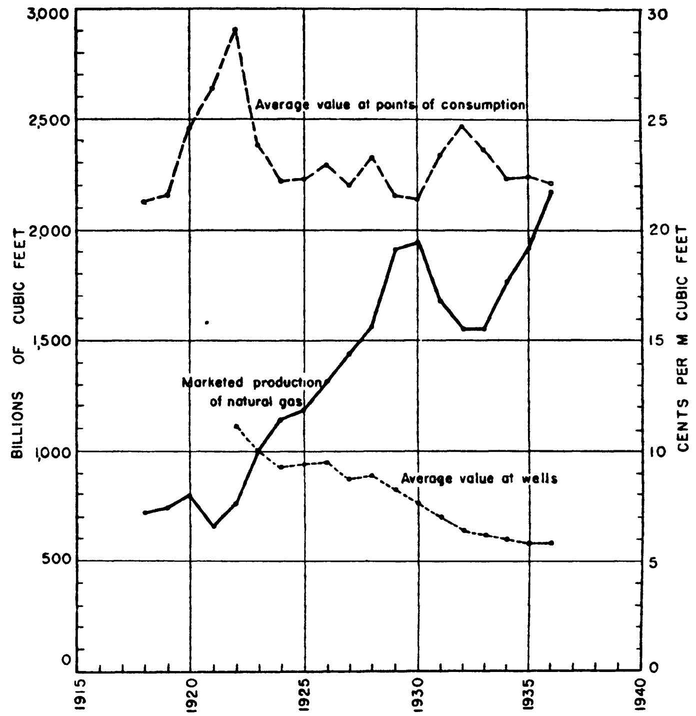


FIGURE 75.—Production and value of natural gas, 1918–36.

value of natural gas at points of consumption declined about 7 percent from 1933 to 1936, it may be assumed that the competitive position of natural gas among the primary fuels has strengthened in recent years.

In general, the consumer price of natural gas reflects principally the field price plus distribution costs. The trend in field prices in recent years has been downward, and in view of the size of developed reserves it appears unlikely that there will be a material increase in this price in the near future.

Indications are that the average distribution cost was reduced in 1936, as many pipe lines operated at a higher percentage of their capacity and as some of the larger systems improved their load factors by expanding their industrial markets. On the other hand, further expansion probably will involve increased capital expenditures and

rising costs for labor and materials, which will tend to prevent a run-away expansion in natural-gas sales at the expense of competing fuels.

In general, far greater confidence has been shown in the last few years as to the adequacy of natural-gas supplies, owing largely to a growing realization of the tremendous developed reserves in the Southwest now within reach of most of the principal cities. The problem of convincing prospective customers of the dependability of natural-gas supplies has always been a real one in the development of new markets. The virtual removal of this handicap in many districts facilitates to a marked degree the "selling" of natural-gas service to new communities. The foregoing does not mean that the factor of gas reserves is no longer vital, but it emphasizes the practical importance of an apparent psychological change in public opinion. The effect of this change is to render less potent the time-honored "dependability" defense of the vendors of competing fuels.

State taxes on natural-gas production have been actively discussed in recent months, particularly in the Southwest. The tax burden carried by natural gas in connection with both production and pipeline operations seems more likely to increase than decrease in the future.

EMPLOYMENT AND EXPENDITURES

Data on employment and expenditures at natural-gas wells were compiled by the Bureau of Mines in cooperation with the Census of Business for 1935. The accompanying table summarizes this information by States.

Employment and expenditures at natural-gas wells in 1935, by States

State	Wage earners		Salaried employees [1]		Expenditures (thousands of dollars)		
	Number [2]	Wages (thousands of dollars)	Number	Salaries (thousands of dollars)	Supplies and materials [3]	Fuel	Purchased electricity
Arkansas	27	26	14	23	22	10	(4)
California	8	10	4	6	9	3	2
Colorado	5	5	3	5	5	3	(4)
Illinois	9	5	6	5	5	10	(4)
Indiana	102	58	70	59	131	18	1
Kansas	353	218	212	283	269	50	10
Kentucky	372	174	177	259	124	75	6
Louisiana	210	199	103	165	99	20	(4)
Michigan	31	26	22	26	22	15	(4)
Mississippi	12	11	6	10	3	10	(4)
Missouri	17	10	10	13	2	10	(4)
Montana	77	72	61	72	33	19	5
New Mexico	6	4	4	6	16	3	(4)
New York	322	362	97	135	307	100	4
Ohio	1,118	1,225	426	714	750	250	10
Oklahoma	405	294	243	288	489	100	10
Pennsylvania	1,760	1,890	528	706	2,125	800	40
Texas	443	314	177	234	586	200	29
Utah, Washington, and South Dakota	5	4	4	6	6	3	(4)
West Virginia	1,980	2,350	593	850	2,000	567	50
Wyoming	26	23	20	36	492	22	(4)
United States	7,288	7,280	2,780	3,901	7,495	2,288	167

[1] In the field only—salaried employees at central administrative offices included with those employed on crude petroleum.
[2] Number of wage earners determined by averaging the total number reported on pay rolls the 15th of each month.
[3] Includes cost of repair parts, machinery supplies, and all other materials and equipment necessary to maintain and operate the wells.
[4] No purchases of electricity reported in partial coverage of the State.

Total wages and salaries for dry-gas production in the field in 1935 were $11,181,000, or about 20 percent of the total value at wells. The average annual wage of about $1,000, received by 7,288 wage earners, is probably somewhat lower than actual rates because at least 1,000 part-time workers are included in the employment figure. Many additional field workers were omitted entirely because their compensation for the year was so low as to indicate that they probably had other more remunerative sources of livelihood. Salaried field employees numbered 2,780 and were paid a total of $3,901,000, an average annual salary of $1,403. The Eastern States have a much higher pay-roll expense per thousand cubic feet of gas produced than do the Southwestern States because of the comparatively small productivity per well in the eastern fields.

Expenditures for supplies and materials at gas wells, exclusive of initial drilling costs and fuel, totaled $7,495,000 in 1935. Total expense for fuel was $2,288,000 and for electric current $167,000.

GROSS PRODUCTION

Virtually all national and State totals of natural-gas production represent a summation of the quantities consumed for all purposes. Complete coverage of the quantity of natural gas reaching the surface by way of the 400,000 or more active oil and gas wells obviously is impossible, but for 1935 a particular effort was made to obtain a closer approach to gross-production totals than had been obtained previously. Estimates of gross production, which are given in the following table by States, represent essentially marketed production plus quantities used in repressuring, stored in the ground, or wasted. The figures on wastage are not complete, as no estimates were made of the quantities blown to the air at wellheads of or unmeasured losses in bringing in and operating wells and testing lines. In general, the figures shown cover residue gas blown to the air, shrinkage at natural-gasoline plants, and an estimate of transmission losses based on reports of "unaccounted-for" gas.

Repressuring.—Repressuring is the injection of gas, generally natural gas, into partly depleted oil and gas reservoirs primarily to increase oil recovery. An incidental but important aspect of repressuring in many fields is the conservation of large volumes of gas which would otherwise be wasted. The present firmness of petroleum prices is stimulating the growth of repressuring in many of the old oil fields.

In 1935 Oklahoma was the leading State in utilization of natural gas for repressuring; 39,055,000,000 cubic feet were returned to oil sands in the State for repressuring. In California 34,237,000,000 cubic feet were injected in 1935 for repressuring. Repressuring activities in nine other States brought the total volume of gas so used in the United States to 90,290,000,000 cubic feet, or nearly 4 percent of the gross production.

Gross production of natural gas in the United States in 1935, by States

[Millions of cubic feet]

State	Estimated production[1]			Estimated disposition			
	From gas wells	From oil wells	Total	Marketed production	Used in repressuring	Stored in the ground	Losses and wastage[2]
Arkansas	4,600	3,000	7,600	6,167	1,023		410
California	9,000	341,000	350,000	284,109	34,237	4,556	27,098
Colorado	2,900	300	3,200	2,843			357
Illinois	50	1,500	1,550	1,448			102
Indiana	1,750	100	1,850	1,777	1		72
Kansas	53,000	15,000	68,000	57,125		5,760	5,116
Kentucky	41,500	2,500	44,000	39,738	562		3,701
Louisiana	242,000	19,000	261,000	249,450	375		11,175
Michigan	2,500	3,000	5,500	4,203			1,297
Mississippi	10,000		10,000	9,643			357
Missouri	615		615	609			6
Montana	20,200	800	21,000	19,870		120	1,010
New Mexico	12,000	19,000	31,000	27,931			3,069
New York	9,300	100	9,400	8,288	4		1,108
Ohio	48,300	3,700	52,000	49,592			2,408
Oklahoma	120,000	225,000	345,000	274,313	39,055		31,632
Pennsylvania	94,000	5,000	99,000	94,464	896	171	3,469
Texas	686,000	340,000	1,026,000	642,366	2,915	578	380,141
West Virginia	113,000	12,000	125,000	115,772	3,934		5,293
Wyoming	22,000	14,000	36,000	26,643	7,288	109	1,960
Other States	290		290	244			45
	1,493,005	1,005,000	2,498,005	1,916,595	90,290	11,294	479,826

[1] Marketed production plus quantities used in repressuring, stored in the ground, lost in handling, and blown to the air.
[2] Includes gas blown to the air at "stripper" plants, shrinkage at natural-gasoline plants, and transportation losses, but does not include wastage at wellheads.

Storage.—The storage of natural gas underground is closely allied to repressuring, as it also involves the return of gas to natural reservoirs. The purpose is to conserve surplus gas for future demand. At some operations dry-gas reservoirs are used, and at others partly depleted oil fields whose structural characteristics are suited to retention of the injected gas. The seasonal variation in demand for natural gas perhaps most frequently necessitates gas storage, particularly in regions where casinghead gas is used extensively for domestic and commercial purposes. Under such conditions, some of the residue casinghead gas produced during the summer months when natural-gas requirements are low is often stored for use in the cold season when consumer demands are heavy.

A total of 11,294,000,000 cubic feet of natural gas was stored in six States in 1935. The 5,760,000,000 cubic feet stored in Kansas and the 4,556,000,000 cubic feet in California represented over 90 percent of the quantity stored.

Waste.—Increasingly vigorous attempts have been made to reduce waste in natural-gas operations. The factors affecting waste in the transportation and distribution of natural gas are relatively simple and easy to classify and they exert a direct effect upon operating efficiency. Ordinarily an immediate financial advantage results from reducing gas waste within practical limits. This has been an effective stimulus to engineering research to improve methods and equipment for transporting, metering, regulating, and utilizing natural gas. Many technical improvements have made possible a considerable reduction in the percentage of gas leakage between the producing fields and the ultimate consumers.

Waste of gas from the standpoint of natural-gas production, however, is a far more intricate problem, as evidenced by the many recent attempts to reduce waste in the Panhandle. The nature of oil and gas production makes the loss of some gas into the atmosphere inevitable; for example, it is virtually impossible to bring in a gas well without some gas escaping. Growing interest in conservation and increasing opportunities to sell gas or put it to use in many fields have helped to improve operating technique to reduce gas waste. There is now a better understanding of the behavior and functions of natural gas in reservoirs, whether dry gas or oil and gas together. Realization that the gas has value in as well as above the ground at times has had a restraining influence upon uneconomic withdrawals.

The greatest losses in recent years and those that have been most difficult to bring under a reasonable degree of control have been the fault of operators whose financial interests seemed best served by producing large amounts of gas solely to extract the relatively small percentage of natural gasoline it contained. Proration and conservation regulations in States producing large quantities of flush oil have reduced the loss of casinghead gas considerably and continued improvement is anticipated. In the Panhandle field of Texas, which was credited with about 67 percent of all the losses in 1935, tremendous volumes of residue gas were still being blown to the air in 1936, although the average wastage in that year was far below that in 1934, the peak year.

MARKETED PRODUCTION

As already stated, the marketed production of natural gas in 1936 is estimated as 2,175,000,000,000 cubic feet, or nearly 260,000,000,000 cubic feet above the final figure (1,916,595,000,000 cubic feet) for 1935. The estimate for 1936 represents a new record, exceeding the previous high of 1930 by 12 percent.

Texas easily retained first rank among the producing States; in fact, its estimated production for 1936 (725,000,000,000 cubic feet) is more than double that of California, which ranked second.

The total value of the production at wells in 1936 is estimated as $126,150,000 compared with $110,402,000 in 1935. Figures on value by States have not been estimated for 1936, but the final figures for 1935 show that the average value at the wells ranged from 1.8 cents per thousand cubic feet in New Mexico to an average of 22.8 cents in New York. The average values at points of consumption for 1935 ranged from 9.7 cents per thousand cubic feet in Oklahoma to 71.3 cents in New York. The spread between the average value at the wells and the average value at points of consumption was largest in Washington, Illinois, and New York.

153336—37——68

Natural gas produced in the United States and delivered to consumers, 1906–35, by States, in millions of cubic feet

Year	Arkansas	California	Colorado	Illinois	Indiana	Kansas	Kentucky	Louisiana	Michigan	Mississippi	Montana	New Mexico
1906	(1)	153	24	410	7, 861	69, 323	789	[2] 1, 039	------	------	------	------
1907	(1)	230	(3)	1, 155	6, 624	76, 707	1, 303	[2] 1, 288	------	------	------	------
1908	(1)	479	(3)	4, 979	5, 256	80, 740	1, 430	[2] 1, 752	------	------	------	------
1909	(1)	2, 324	(3)	8, 473	6, 159	75, 074	2, 097	[2] 4, 365	1	------	------	------
1910	(1)	2, 764	(3)	6, 723	5, 760	59, 380	1, 357	[2] 8, 110	1	------	------	------
1911	(1)	6, 390	(3)	6, 762	4, 365	38, 800	1, 275	[4] 9, 786	2	------	------	------
1912	(1)	9, 355	(3)	5, 603	3, 618	28, 068	1, 951	[4] 14,493	2	------	------	------
1913	(1)	11, 035	(3)	4, 767	2, 921	22, 884	1, 821	[4] 26,653	2	------	------	------
1914	(1)	17, 829	(3)	3, 548	2, 580	22, 628	1, 422	[4] 26,775	2	------	------	------
1915	[5] 992	21, 891	(3)	2, 690	2, 261	27, 046	1, 667	25, 540	2	------	6	------
1916	2, 388	31, 643	(3)	3, 534	1, 715	31, 710	2, 107	32, 081	1	------	213	------
1917	5, 610	49, 427	(3)	4, 439	1, 712	24, 439	2, 802	31, 287	1	------	334	------
1918	5, 295	39, 719	10	4, 473	1, 667	27, 825	3, 022	36, 094	1	------	177	------
1919	5, 587	55, 607	10	3, 825	1, 407	16, 150	2, 057	47, 062	1	------	858	------
1920	9, 027	66, 041	9	3, 013	1, 779	21, 158	3, 345	58, 274	(1)	------	818	------
1921	4, 260	75, 942	4	2, 646	1, 066	15, 717	4, 820	58, 004	(1)	------	336	------
1922	9, 700	84, 580	4	3, 383	947	20, 289	5, 872	70, 267	1	------	486	(3)
1923	24, 215	131, 434	1	4, 049	880	30, 913	11, 953	112, 031	1	------	1, 470	(3)
1924	36, 616	189, 692	48	4, 072	998	25, 580	12, 875	160, 945	1	------	1, 071	------
1925	41, 878	187, 789	574	4, 165	1, 168	26, 917	10, 770	152, 620	(1)	------	1, 496	(3)
1926	43, 566	204, 915	554	3, 808	901	38, 095	10, 410	157, 423	(1)	------	2, 283	921
1927	30, 450	212, 364	1, 725	3, 741	1, 124	42, 646	10, 246	186, 961	1	(3)	4, 253	1, 019
1928	20, 235	246, 215	2, 931	3, 051	1, 290	45, 644	15, 383	227, 821	469	(3)	6, 277	838
1929	19, 928	342, 214	2, 787	2, 983	1, 012	38, 469	27, 588	261, 138	4, 526	90	9, 659	3, 054
1930	18, 585	334, 789	3, 312	2, 890	1, 217	37, 630	28, 023	278, 341	2, 075	179	10, 060	9, 497
1931	13, 300	305, 930	2, 536	2, 130	1, 337	38, 742	27, 870	224, 155	472	6, 048	10, 949	19, 354
1932	10, 235	263, 484	2, 547	1, 769	1, 349	40, 690	29, 005	201, 561	968	8, 648	13, 295	17, 604
1933	8, 288	259, 799	2, 449	1, 631	1, 544	41, 596	31, 380	197, 826	1, 528	8, 679	14, 391	19, 148
1934	7, 024	268, 122	2, 633	1, 868	1, 802	46, 909	33, 124	225, 713	2, 789	8, 245	14, 971	24, 075
1935	6, 167	284, 109	2, 843	1, 448	1, 777	57, 125	39, 738	249, 450	4, 203	9, 643	19, 870	27, 931

Year	New York	Ohio	Oklahoma	Pennsylvania	Texas	West Virginia	Wyoming	Others	Total	Value at points of consumption	
										Total (thousands of dollars)	Average per M cubic feet (cents)
1906	2, 548	45, 436	3, 520	138, 161	(2)	119, 400	(1)	179	388, 843	46, 874	12. 1
1907	3, 288	52, 041	4, 867	135, 516	(2)	122, 687	(1)	916	406, 622	54, 222	13. 3
1908	3, 843	47, 442	11, 925	130, 476	(2)	112, 181	(1)	1, 638	402, 141	54, 640	13. 6
1909	4, 696	53, 223	28, 037	127, 697	(2)	166, 435	(1)	2, 125	480, 706	63, 207	13. 1
1910	6, 010	48, 232	50, 430	126, 867	(2)	190, 706	(1)	2, 815	509, 155	70, 756	13. 9
1911	5, 240	49, 450	67, 276	108, 869	5, 508	206, 891	(1)	2, 384	512, 993	74, 622	14. 5
1912	8, 626	56, 210	73, 799	112, 150	7, 470	239, 007	(1)	1, 851	562, 203	84, 564	15. 0
1913	8, 515	50, 612	75, 018	118, 860	12, 160	245, 454	(1)	1, 196	581, 898	87, 847	15. 1
1914	8, 935	68, 270	78, 167	110, 745	13, 424	236, 489	(1)	1, 043	591, 867	94, 116	15. 9
1915	7, 977	79, 510	87, 517	113, 692	13, 324	244, 004	(1)	460	628, 579	101, 312	16. 1
1916	8, 036	69, 888	123, 517	130, 484	15, 810	299, 319	(1)	724	753, 170	120, 227	16. 0
1917	8, 372	68, 917	137, 384	133, 397	17, 047	308, 617	(1)	1, 325	795, 110	142, 089	17. 9
1918	8, 461	61, 261	124, 317	123, 813	13, 440	265, 161	4, 339	1, 926	721, 001	153, 554	21. 3
1919	8, 124	63, 153	163, 649	113, 489	24, 710	234, 095	6, 014	118	745, 916	160, 888	21. 6
1920	8, 419	58, 938	154, 467	125, 787	37, 063	239, 719	10, 312	41	798, 210	196, 194	24. 6
1921	6, 583	47, 412	124, 058	86, 144	44, 504	174, 921	15, 608	27	662, 052	174, 617	26. 4
1922	6, 947	51, 481	140, 631	101, 276	47, 945	195, 268	23, 427	22	762, 546	221, 535	29. 1
1923	6, 497	53, 812	203, 082	112, 562	74, 535	203, 867	35, 523	151	1, 006, 976	240, 001	23. 8
1924	6, 196	47, 396	214, 452	105, 863	107, 247	182, 285	46, 036	148	1, 141, 521	253, 856	22. 2
1925	6, 210	43, 235	249, 285	101, 632	134, 872	180, 345	45, 539	76	1, 188, 571	265, 271	22. 3
1926	7, 027	47, 363	286, 421	107, 089	175, 392	180, 223	46, 567	61	1, 313, 019	300, 168	22. 9
1927	5, 908	51, 381	326, 864	105, 709	254, 063	162, 375	43, 582	1, 056	1, 445, 428	317, 930	22. 0
1928	7, 224	56, 341	320, 861	99, 466	301, 990	163, 018	47, 490	1, 595	1, 568, 139	363, 726	23. 2
1929	8, 387	57, 936	357, 893	101, 951	464, 928	167, 333	44, 648	1, 169	1, 917, 693	413, 276	21. 6
1930	9, 624	63, 394	348, 116	88, 706	517, 880	144, 180	43, 219	1, 704	1, 943, 421	416, 090	21. 4
1931	7, 868	56, 326	263, 685	74, 797	464, 580	124, 797	39, 770	1, 790	1, 686, 436	392, 816	23. 3
1932	8, 813	51, 466	255, 487	61, 611	456, 832	100, 540	28, 938	1, 148	1, 555, 990	384, 632	24. 7
1933	6, 865	47, 929	245, 759	63, 579	475, 691	100, 653	25, 830	909	1, 555, 474	368, 540	23. 7
1934	6, 278	50, 330	254, 457	86, 238	602, 976	109, 161	23, 148	858	1, 770, 721	395, 378	22. 3
1935	8, 288	49, 592	274, 313	94, 464	642, 366	115, 772	26, 643	853	1, 916, 595	429, 374	22. 4

[1] Less than 500,000 cubic feet.
[2] Alabama and Texas included with Lousiana.
[3] Included under "Others"; separate figures not available for publication.
[4] Includes Alabama.
[5] Includes gas piped from Oklahoma and consumed in Arkansas.

Natural gas produced and consumed in the United States in 1935, by States

State	Produced and delivered to consumers, including deliveries in other States						Consumed, including receipts from other States			
	Quantity		Estimated value at the wells		Value at points of consumption		Quantity		Value at points of consumption	
	M cubic feet	Percent of total	Total	Average per M cubic feet (cents)	Total	Average per M cubic feet (cents)	M cubic feet	Percent of total	Total	Average per M cubic feet (cents)
Ala.							10,563,000	0.6	$2,881,000	27.3
Ariz.							5,603,000	.3	1,963,000	35.0
Ark.	6,167,000	0.3	$443,000	7.2	$1,400,000	22.7	26,476,000	1.4	6,012,000	22.7
Calif.	284,109,000	14.8	19,916,000	7.0	81,485,000	28.7	284,109,000	14.9	81,485,000	28.7
Colo.	2,843,000	.2	101,000	3.6	646,000	22.7	17,233,000	.9	5,659,000	32.8
D. C.							2,707,000	.1	2,126,000	78.5
Fla.							692,000	(1)	230,000	33.2
Ga.							8,082,000	.4	3,901,000	48.3
Ill.	1,448,000	.1	122,000	8.4	844,000	58.3	57,319,000	3.0	33,405,000	58.3
Ind.	1,777,000	.1	375,000	21.1	1,081,000	60.8	15,613,000	.8	4,798,000	30.7
Iowa							19,077,000	1.0	6,416,000	33.6
Kans.	57,125,000	3.0	2,925,000	5.1	18,153,000	31.8	72,806,000	3.8	16,756,000	23.0
Ky.	39,738,000	2.1	4,819,000	12.1	17,730,000	44.6	15,826,000	.8	6,902,000	43.6
La.	249,450,000	13.0	8,756,000	3.5	46,468,000	18.6	151,934,000	8.0	16,401,000	10.8
Md.							784,000	(1)	639,000	81.5
Mich.	4,203,000	.2	422,000	10.0	1,973,000	46.9	4,203,000	.2	1,973,000	46.9
Minn.							10,579,000	.6	5,152,000	48.7
Miss.	9,643,000	.5	426,000	4.4	2,259,000	23.4	8,765,000	.5	2,491,000	28.4
Mo.	609,000	(1)	87,000	14.3	282,000	46.3	33,060,000	1.7	14,529,000	43.9
Mont.	19,870,000	1.0	785,000	4.0	5,587,000	28.1	[2] 16,832,000	.9	4,405,000	26.2
Nebr.							14,310,000	.8	5,291,000	37.0
N. Mex.	27,931,000	1.5	508,000	1.8	4,292,000	15.4	18,419,000	1.0	1,938,000	10.5
N. Y.	[3] 8,288,000	.4	1,892,000	22.8	5,909,000	71.3	35,705,000	1.9	17,199,000	48.2
N. Dak.							1,382,000	.1	517,000	37.4
Ohio	49,592,000	2.6	8,158,000	16.5	24,179,000	48.8	105,896,000	5.5	51,969,000	49.1
Okla.	274,313,000	14.3	6,693,000	2.4	26,541,000	9.7	258,598,000	13.5	20,264,000	7.8
Pa.	[4] 94,464,000	4.9	20,282,000	21.5	39,434,000	41.7	91,601,000	4.8	38,531,000	42.1
S. Dak.	8,000	(1)	500	6.3	3,000	37.5	4,656,000	.2	1,567,000	33.7
Tenn.							9,479,000	.5	3,382,000	35.7
Tex.	[5] 642,366,000	33.5	13,233,000	2.1	101,046,000	15.7	525,697,000	27.5	49,773,000	9.5
Utah	98,000	(1)	4,000	4.1	22,000	22.4	8,747,000	.5	1,939,000	22.2
Va.							343,000	(1)	341,000	99.4
Wash.	138,000	(1)	11,500	8.3	95,000	68.8	138,000	(1)	95,000	68.8
W. Va.	115,772,000	6.1	19,612,000	16.9	45,820,000	39.6	53,763,000	2.8	14,948,000	27.8
Wyo.	26,643,000	1.4	831,000	3.1	4,125,000	15.5	18,904,000	1.0	2,196,000	11.6
Total,	1,916,595,000	100.0	110,402,000	5.8	429,374,000	22.4	1,903,901,000	100.0	428,074,000	22.4
1934	1,770,721,000	100.0	106,438,000	6.0	395,378,000	22.3	1,764,988,000	100.0	394,257,000	22.3

[1] Less than 0.05 percent.
[2] Includes 106,000 M cubic feet piped from Canada.
[3] Includes 29,000 M cubic feet piped to Canada.
[4] Includes 44,000 M cubic feet piped to Canada.
[5] Includes 6,727,000 M cubic feet piped to Mexico.

WELLS

The increased demand for natural gas caused a material increase in field activity, and 2,070 gas wells were brought in during 1936 compared with 1,401 in 1935. Most of the completions in 1936 were in the Eastern States, but on the basis of potential or initial capacity completions in Texas probably outranked those in all the Eastern States combined.

In 1935 the number of producing gas wells declined from 54,130 on January 1 to 53,790 on December 31, indicating the abandonment of 1,741 wells. If the same rate of abandonment is assumed for 1936 the total number of wells producing at the beginning of 1937 is very close to that of December 31, 1934. Although the number of producing wells apparently is not increasing, the size of the shut-in reserves probably is growing larger as the large wells in the Midcontinent area replace the small wells of the Eastern States.

Gas wells in the United States, 1934-36

State	Number of producing gas wells, Dec. 31, 1934	Number of gas wells drilled during 1935 [1]	Number of producing gas wells, Dec. 31, 1935	Number of gas wells drilled during 1936 [1]
Arkansas	170	2	180	5
California	30	34	30	12
Colorado	20	1	20	1
Illinois	90	----------	80	----------
Indiana	1,010	74	970	59
Kansas	2,950	39	2,700	61
Kentucky	[2] 2,350	16	2,340	10
Louisiana	[2] 1,360	104	1,370	134
Michigan	110	103	170	212
Mississippi	[2] 110	3	110	4
Missouri	[2] 160	----------	140	----------
Montana	[2] 340	17	350	34
New Mexico	30	4	30	17
New York	2,030	(3)	2,030	(3)
Ohio	6,570	245	6,400	409
Oklahoma	2,710	110	2,640	126
Pennsylvania	19,410	[3] 61	19,270	[3] 131
Texas	[2] 1,900	276	2,000	388
Utah, Washington, and South Dakota	20	2	30	1
West Virginia	12,660	304	12,820	458
Wyoming	100	6	110	8
	[2] 54,130	1,401	53,790	2,070

[1] From Oil and Gas Journal. [2] Revised figures. [3] New York included with Pennsylvania.

REVIEW OF FIELD DEVELOPMENTS BY STATES

Arkansas.—Production of natural gas in Arkansas in 1936 increased approximately 2,000,000,000 cubic feet or 30 percent over 1935, according to information furnished by George C. Branner, State geologist. Completion of J. D. Reynolds No. 1 in sec. 27, T. 15 S., R. 15 W. (Ouachita County), on the northeast flank of the old Smackover oil field, opened up new gas reserves in the Permian lime. Four additional wells producing varying amounts of natural gas and distillate were completed in the area before the end of the year. Two small gas wells were completed in the Smackover area of Union County.

In Nevada County, the Grove Land & Timber Co. No. 2 was completed late in the year with a reported initial capacity of 40,000,000 cubic feet of gas per day from the Nacatoch sand at 1,242 feet. The well is in sec. 10, T. 14 S., R. 20 W., a few miles southeast of Irma.

In western Arkansas three gas-well completions were reported as follows: One in the Roland-Dora field of Crawford County, one in the Vesta field of Franklin County, and one in Sebastian County. Nine gas wells were abandoned in Crawford County and two in Franklin County.

An active leasing campaign was carried on during the year in the southwestern counties of the State, based upon geophysical and subsurface geological investigations. Increased exploratory drilling is expected in 1937.

California.—The most significant natural-gas development in California during 1936 was an increase of almost 17 percent in sales of gas to utilities, reflecting a continued expansion in demand for industrial and other purposes. The following comments are based on data taken from a report by Claude C. Brown, chief engineer, Railroad Commission, State of California.

Total production of natural gas increased approximately 15 percent—from 304,867,400,000 to 350,807,100,000 cubic feet, including 24,028,900,000 cubic feet blown to the air. Sales to utilities and others of 214,574,300,000 cubic feet represented 61.2 percent of gross production compared with 60.17 percent in 1935 and 59.6 percent in 1934. The utilities sold 57,000,000,000 cubic feet of natural gas to domestic consumers, 14,000,000,000 to commercial consumers, and 82,000,000,000 to industrial plants. Twenty-one billion cubic feet were used in generating electric power, 11,000,000,000 were utilized for company purposes, and 15,000,000,000 were sold to other than utility companies. Distribution losses were about 15,000,000,000 cubic feet. The total number of meters connected to gas pipe lines in California at the end of 1936 was 1,541,000, an increase of 61,000 over 1935.

Salient statistics of natural-gas industry in California, 1935–36 [1]

Use	1935		1936	
	M cubic feet	Percent of total	M cubic feet	Percent of total
Repressuring and storage	3,892,700	1.3	9,772,000	2.8
Gasoline-plant fuel and shrinkage	50,032,000	16.4	52,332,500	14.9
Field fuel	39,310,000	12.9	43,783,200	12.5
Other fuel (refineries)	8,804,700	2.9	6,316,200	1.8
Sales to utilities and others	183,453,400	60.2	214,574,300	61.2
Blown to the air	19,374,600	6.3	24,028,900	6.8
Total net production	304,867,400	100.0	350,807,100	100.0

[1] Figures compiled by Claude C. Brown, chief engineer, Railroad Commission, State of California.

The natural gas now being produced in California comes from 39 principal oil and gas fields of which 30 produce casinghead gas with oil and 9 dry gas only. Of the dry-gas fields, Buena Vista Hills, Buena Vista Lake, Buttonwillow, McDonald Island, Rio Vista, Semi Tropic, Tracy, and Trico are in the San Joaquin Valley area, and La Goleta is in the Coastal area. The dry-gas fields of the State are relatively unimportant, having produced only 5,000,000,000 cubic feet (1.4 percent of the total) in 1936.

The oil fields producing casinghead gas are distributed among the three productive districts of the State: San Joaquin Valley, Coastal, and Los Angeles Basin. The Kettleman-North Dome field was the source of 109,000,000,000 cubic feet of the 1936 production. Ventura with an output of 39,000,000,000 and Belridge with 36,000,000,000 were the next most productive areas.

The tremendous gas reserves at Kettleman Hills-North Dome are conveniently located about midway between the important markets of San Francisco and Los Angeles. There are 161 wells which range in depth from 7,000 to 8,000 feet and produce from five characteristically thick pay zones. Original bottom-hole pressures averaged about 2,800 pounds per square inch but have now been reduced to 1,250 pounds in some parts of the field. The productive area covers about 16,500 acres.

The first major field discovered in California through the use of geophysical methods of prospecting was opened up on June 2, 1936, by the K. C. L. Stevens No. A-1 well, 14 miles southwest of Bakersfield

in Kern County. It is known as the Ten Section field. The discovery well made 16,000,000 cubic feet of wet gas per day and 1,093 barrels of 61.5° A. P. I. gravity oil from 7,900 feet, with a gas pressure of 2,300 pounds on the casing and 1,950 pounds on the tubing. Other discoveries of the year included the Rio Vista dry-gas field, the Greeley field north of Ten Section, and the Tulare Lake Bed development. Deeper producing sands were proved at Torrance and other fields.

During the year 802 new wells were completed, of which 790 produced oil and gas and 12 dry gas only; 772 existing wells were deepened or redrilled and 449 abandoned.

From the best information available today, a reasonable estimate of the recoverable gas remaining in known reserves would approximate 25 trillion cubic feet. These reserves are thought to be sufficient to meet the estimated demand for 50 years.

No major gas lines were laid during 1936. The Tracy gas field, San Joaquin County, was provided with an outlet to a trunk line by construction of 10 miles of 8-inch line. Several of the newer gas fields will probably be connected to markets in the near future.

Colorado.—Natural-gas development continued to be very limited in Colorado during 1936; no new discoveries were made, and only one gas-well completion was reported. Data have been compiled by H. J. Duncan, supervisor, United States Geological Survey, Casper, Wyo.

The lone gas well resulted from a deepening operation in sec. 16, T. 3 N., R. 91 W., in the Thornburg field of Moffat County. A Dakota-sand gas well was drilled into the Nugget sand, where it had a flow of 2,500,000 cubic feet per day with a closed-in pressure of 900 pounds per square inch. A 22-mile, 3-inch line was laid from the Thornburg field to the town of Craig to augment the failing gas supply from the old Craig field.

Of the total 1936 marketed production in Colorado of 2,986,036,000 cubic feet, 2,791,195,000 came from the Hiawatha field (Colorado part) and was piped to Salt Lake City, Utah, and vicinity. The balance of the gas produced came from the Garcia (96,000,000), Berthoud (41,800,000), Craig (34,576,000), and Thornburg (22,465,000) fields. The Berthoud gas supplies towns in northern Colorado and Cheyenne, Wyo. Gas in the Garcia field is put through a gasoline plant and the residue used for fuel.

The following gas fields are shut in for lack of a market: Bell Rock and Powder Wash, Moffat County; Piceance Creek, Rangely, and White River, Rio Blanco County; and Garmesa, Garfield County.

It is estimated that 787,000,000 cubic feet of carbon dioxide gas was produced and wasted in the North and South McCallum fields of Jackson County. No commercial use has been found for this gas owing to its contamination by oil.

Illinois.—A. H. Bell, geologist and head of the Oil and Gas Division, Illinois State Geological Survey, has furnished the following data on natural-gas developments in Illinois.

No new gas fields were discovered in Illinois in 1936. Three gas wells were completed during the year, one in Bond County, one in Clark County, and one in Wabash County. The well in Bond County extended the producing area of the Ayers gas field to the west, adding an estimated 30 acres. The producing sand is the "Second Lindley" (the Bethel sandstone of the Chester series). Initial open-flow capac-

ity was estimated at 1,500,000 cubic feet per day. The Ayers gas field furnishes gas for municipal and industrial use in the town of Greenville.

The gas from the new wells in Clark and Wabash Counties is not being marketed and is being used only for power on the leases.

Indiana.—Although drilling for gas was somewhat less active in Indiana in 1936 than in 1935, enough new production was developed to check the decline in supply, according to a report furnished by M. M. Fidlar, State gas supervisor, Indiana Conservation Department.

There were four outstanding scenes of activity in the gas fields of southwestern Indiana. Ten new gas wells were completed in the Oaktown field, Knox County, which brought the total number in this field to 38. During 1936 the Oaktown field became the largest source of natural gas in the State, furnishing more than 678,000,000 cubic feet and surpassing the output of the Alford field of Pike County. Production from the latter field continued to decline and amounted to approximately 400,000,000 cubic feet in 1936. Gas from these fields is consumed in cities of southwestern Indiana.

Six gas wells of small capacity were completed in the gas area in eastern Daviess County. A pipe line into the area is planned for the near future. In the Tell City field in Anderson Township, Perry County, five gas wells were completed, making a total of nine producing wells at the end of 1936 with a total open-flow capacity of approximately 20,000,000 cubic feet per day. Five gas wells were added to the gas field in Jefferson Township, Pike County, which was discovered in 1935. Drilling is expected to continue in 1937.

In all, 53 gas wells were completed in Indiana in 1936, of which 10 were of the wildcat variety. The demand for natural gas still exceeded the State production, and it is expected that active development will continue in Daviess, Pike, Gibson, and Perry Counties.

The old Trenton field of northeastern and east-central Indiana continued to furnish about 375,000,000 cubic feet of gas annually. Several wells of small daily potential were completed and were connected to pipe lines serving nearby towns. More than 700 wells are producing gas in the Trenton area, but many of these are used for private supply. If the Trenton wells are included, over 900 wells were producing natural gas in Indiana at the end of 1936. It is estimated that 90 percent of their product is used for domestic and commercial purposes.

Kansas.—Oil and gas development was extremely active and successful in Kansas in 1936. Statistical data on gas-well completions have been furnished by Kenneth K. Landes, assistant State geologist, Geological Survey of Kansas.

Eighty-eight gas wells were completed during the year, including 14 pool openers. Their total open-flow capacity exceeded 800,000,000 cubic feet per day. Among the gas wells are 24 wells which also produced oil. Completions in the older fields of eastern Kansas are not included because information concerning this area is lacking. The discoveries were as follows: Three each in Cowley and Haskell Counties, two in Finney, and one each in Barton, Elk, Grant, Pawnee, Pratt, and Rice Counties.

The Burrton-Stone field of Reno County was the most active area, with 18 completions listed. The wells ranged in capacity from 1 to 30 million cubic feet per day of gas. About half of the wells produced moderate amounts of oil in addition to gas. In the Hugoton field of

Stevens and Morton Counties, 17 wells were completed which ranged in capacity from 1.5 to 18 million cubic feet. The other gas field of outstanding importance in 1936 was Otis, in Reno County. Eleven gas wells were drilled, several of which exceeded 40,000,000 cubic feet per day in capacity. Two of these wells also produced oil. Production in the Otis field comes from the Reagan sand.

At the end of the year development was active in the central and western parts of the State, being stimulated by the increased demand.

Kentucky.—The natural-gas industry in Kentucky continued in 1936 to follow a course similar to that in 1935. The following information is taken from a report prepared for the American Institute of Mining and Metallurgical Engineers, by C. D. Hunter, geologist, Kentucky-West Virginia Gas Co.; I. B. Browning, geologist and operator, Ashland, Ky.; and N. W. Shiarella, geologist and operator, Owensboro, Ky.

Drilling was carried on at about the same, or a slightly increased, rate over that of 1935. In the important eastern Kentucky Devonian-shale gas area of Floyd, Martin, Pike, Knott, and Magoffin Counties more than 100 shale wells were drilled to maintain delivery capacity that would be adequate to meet pipe-line demands. The open-flow capacity of these wells averaged approximately 400,000 cubic feet per day each. The discovery and recent development of the large Oriskany-sand gas field in Kanawha County, W. Va., 100 miles to the northeast, have had no evident effect upon development of or demand for eastern Kentucky gas.

Seventy-two new gas wells with a total open-flow capacity of 70,000,000 cubic feet per day were completed in 1936 in the northwestern Kentucky fields of Ohio, Hancock, Daviess, McLean, Henderson, and Webster Counties. The producing sands range from Middle Mississippian to Middle Pennsylvanian in age. Most of the production comes from the Barlow, Jones, and Jett sands of the Chester series.

Considerable gas has been produced in connection with the development of the Bates Knot oil field, southwest of Livermore in McLean County. This structure is a faulted anticline and has proved a large producer of gas from both the Chester sands and the Pottsville sand. One well in the Jett sand (Tar Springs) had an open flow of 21,000,000 cubic feet per day at 1,220 feet. Three wells on this structure had flows of 13,000,000, 8,000,000, and 4,000,000 cubic feet, respectively, from the Pottsville sand at depths of 750 to 790 feet.

Increasing quantities of gas are being used in Kentucky for repressuring in the oil fields, particularly in the "Corniferous" lime and Weir sand pools of eastern Kentucky and to a smaller extent in western Kentucky.

Louisiana.—The natural-gas industry in Louisiana in 1936 was featured by an increase in drilling and production, particularly in the northern part of the State according to information supplied by Cyril K. Moresi, State geologist of Louisiana.

Gas-well completions increased almost 50 percent, or from 104 in 1935 to 155 in 1936. Intensive activity in the Monroe and Rodessa fields accounted for this gain and for 87 percent of the new gas wells in the entire State. The Monroe field continued to dominate the gas situation with 100 completed wells, followed by the Rodessa field with 35.

Marketed production of gas in Louisiana increased 17 percent over

1935 to 293,000,000,000 cubic feet. The accompanying table, which shows distribution of gas from the Monroe, Richland, and Epps fields of northeastern Louisiana, accounts for most of the gas produced.

Distribution of gas produced from the Monroe, Richland, and Epps gas fields, 1935–36 [1]

	1935 (M cubic feet)	1936 (M cubic feet)
Burned in carbon-black manufacture	54,113,611	45,916,169
Put into gas pipe lines	146,928,933	171,679,153
Utilized in the field	1,051,151	840,636
Unaccounted for, losses, etc	1,924,795	1,466,017
Total production	204,018,490	219,901,975

[1] Data furnished by C. K. Moresi, State geologist, Louisiana.

In the Rodessa field, Caddo Parish, gas production put in lines increased about 20,000,000,000 cubic feet to 42,411,550,000 in 1936. The next most important gas area was the Sligo field in Bossier Parish, where output almost doubled to 8,756,643,000 cubic feet. In southern Louisiana there were important increases in gas production from the Bunkie field in Rapides Parish and the Bosco field in Acadia and St. Landry Parishes. The Iowa field in Calcasieu and Jefferson Davis Parishes continued to furnish about 4.5 billion cubic feet annually.

In the table on Monroe, Richland, and Epps production, it is interesting to note that the long-distance pipe lines continue to take greater proportions of gas at the expense of quantities disposed of in carbon-black production, field use, and various losses. Although the national demand for carbon black has been increasing rapidly, gas used for its production in Louisiana decreased about 14 percent, indicating a tendency to conserve the available gas in this district for markets where it commands a higher price.

Three new wet-gas fields were discovered in the northern part of the State during the year. The discovery well of the Sibley field, Webster Parish, was completed in June 1936 and had an initial capacity of 28,730,000 cubic feet per day from the Lower Glen Rose formation at 5,590 feet. Two more comparable wells were completed by the end of the year, but no pipe-line connection had been made. The Driscoll field, Bienville Parish, was discovered in April 1936. The initial production was 70,750,000 cubic feet, also from the Lower Glen Rose formation, at 6,141 feet. A third discovery from the same formation, now known as the Montcalm field, Lincoln Parish, was brought in from a depth of 6,576 feet and gaged 67,634,000 cubic feet per day. The two latter wells are producing into pipe lines. Gas was produced from deeper sands at Lake Bastineau, Bienville Parish, and Sligo, Bossier Parish.

Michigan.—Rapid growth of the natural-gas industry in Michigan continued in 1936. F. R. Frye, petroleum engineer, Michigan Department of Conservation, has furnished the following information on field developments.

Gas-well completions increased more than 100 percent over 1935 to a total of 206, 165 in old and 41 in new fields. Initial productive capacities were greater on the average than in previous years, being influenced by numerous completions in the Six Lakes field, where comparatively large wells are common. This gas field has become the

largest in the State; it extends more than 10 miles in length and has over 200 wells.

Two new gas fields were developed during the year; the Shaver field in Tps. 10 and 11 N., R. 4 W., Gratiot County, and the Ravenna field in T. 9 N., Rs. 14 and 15 W., Muskegon County. In the former, wells range in capacity from 1,000,000 to 25,000,000 cubic feet per day and in the latter from 300,000 to 3,000,000 cubic feet.

Gross gas production is estimated to have increased approximately 25 percent to 6,864,000,000 cubic feet, including about 1,850,000,000 casing-head and the balance dry gas. The Six Lakes, Austin, and Broomfield fields were the outstanding sources of dry gas. All produce from the Michigan "stray" sandstone, as do the other central Michigan dry-gas fields.

The most important natural-gas pipe-line development of the year was the construction and placing in service of 235 miles of 22-inch line to Detroit from a point near Zionsville, Ind. Deliveries were begun on July 9, 1936, and amounted to more than 3,800,000,000 cubic feet by the end of the year. The gas is piped from the Panhandle field of Texas.

The market for Michigan natural gas was expanded during the year by the inauguration of service to Lansing and Grand Rapids through new lines from the Six Lakes area.

Mississippi.—Information on natural-gas production and drilling in Mississippi during 1936 has been supplied by Henry N. Toler, State oil and gas supervisor.

The production of 13,004,835,000 cubic feet of natural gas established an all-time record for the State by a wide margin, being 2,619,706,000 cubic feet greater than the former peak in 1935. Virtually the entire output came from the Jackson field in Hinds and Rankin Counties. The only other production in Mississippi, that from the Amory field, Monroe County, declined to 36,264,000 cubic feet. A total of 5,275,962,000 cubic feet of gas from the Jackson field was piped outside the State to Alabama, Florida, and Louisiana.

Three producing gas wells and three dry holes were drilled in the Jackson field during the year. No drilling was done in the Amory field.

Ninety-nine gas wells were producing in the Jackson field and only one in the Amory field at the end of 1936.

Seven dry wildcats were completed in the coastal part of the State. In Wilkinson County a show of oil was found in the Cockfield formation below 3,800 feet in the Foster Creek Lumber Co. No. 1 well, sec. 8, T. 3 N., R. 1 E. In the same county, the Lanehart No. 1 well, sec. 22, T. 1 N., R. 2 W., had a showing of oil in the Miocene formation from 4,572 to 4,579 feet. The most significant wildcat development was the discovery in the Scanlon and Semmes No. 1 well, sec. 28, T. 4 N., R. 15 W., Lamar County, of the first salt dome that has been found in Mississippi. Salt was encountered below thick anhydrite at 2,522 feet.

Missouri.—According to the Biennial Report of 1937 of the Missouri State geologist, field activity in Missouri during 1936 continued on a routine basis, and completions numbered approximately 80, of which about 20 were gas wells and 40 dry holes. Almost two-thirds of all drilling was done in Jackson County. At the end of the year a pipe line was being built into T. 49 N., R. 32 W., to take gas from an extension of the old gas field in that area.

The largest well completed during 1936 had an initial capacity of 2,149,000 cubic feet from the Squirrel sand at 575 feet. It is in the Hammond gas field at Plattsburg, Clinton County.

Montana.—Drilling and production of natural gas in Montana increased moderately during 1936, according to a report prepared by H. J. Duncan, supervisor, United States Geological Survey, Casper, Wyo.

In old fields, 31 gas wells with a total open-flow capacity of 155,000,000 cubic feet were completed. A new gas discovery of some importance was made on the Price Dome or Duck Creek structure in Yellowstone County by completion of Metzger No. 1 with a capacity of about 10,000,000 cubic feet daily from a depth of 1,008 feet. It is shut in, as no market is available. Another discovery, probably of minor importance, was made on the Winifred structure, Fergus County, when a well in sec. 26, T. 22 N., R. 17 E., developed 200,000 cubic feet of gas from 392 to 505 feet. A second well was drilled to the sand before the end of the year.

The only pipe-line activity in 1936 comprised minor extensions to gathering lines and the construction of a small distribution system in the town of Cole, Phillips County. A booster station was added to the line from the Cedar Creek field to the Black Hills of South Dakota.

As indicated in the accompanying table total gas production in 1936 was 22,830,626,000 cubic feet, an increase of 16 percent over that of 1935. There were substantial increases in withdrawals from the three largest fields and smaller increases in the production from all other producing fields except Bowes. Industrial sales rose to an estimated total of 9,150,000,000 cubic feet, stimulated particularly by larger demands from the copper industry. Approximately 11,000,000,000 cubic feet were used for domestic and commercial purposes, 1,680,000,000 in field operations, and 1,000,000,000 in public-utility power plants.

Production and distribution of natural gas in Montana in 1936 [1]

Source		Destination	Quantity delivered (M cubic feet)
Field	County		
Bowes	Blaine	Havre and Chinook	431,895
Boxelder	Hill	do	460,565
Bowdoin	Phillips	Malta, Glasgow, Fort Peck, and other towns	965,243
Cedar Creek	Fallon	Miles City and Glendive, Mont.; Rapid City, S. Dak.; Bowman, Bismarck, and Williston, N. Dak.; and intervening towns.	7,325,017
Cut Bank	Glacier	Cut Bank, Helena, Butte, Anaconda, and intervening towns.	8,808,985
Dry Creek	Carbon	Bozeman, Livingston, Big Timber, and intervening towns.	730,034
Hardin	Big Horn	Town of Hardin	78,170
Kevin-Sunburst	Toole	Shelby, Great Falls, and intervening towns	3,287,500
Whitlash	Liberty	Great Falls and intervening towns	743,217
			22,830,626

[1] Data supplied by H. J. Duncan, supervisor, U. S. Geol. Survey, Casper, Wyo.

New Mexico.—The principal development in the natural-gas situation in New Mexico during 1936 was a marked increase in demand. Data on northwestern New Mexico have been compiled by H. J. Duncan, supervisor, United States Geological Survey, Casper, Wyo., and those on the southeastern part of the State by E. A. Hanson, United States Geological Survey, Roswell, N. Mex.

In southeastern New Mexico 13 gas wells with a total initial capacity of 272,000,000 cubic feet were completed, mostly incidental to the very active oil-development campaign in Lea County. There was little incentive to drill for gas because the available supply greatly exceeds prospective demand for the near future.

A total of 16,747,000,000 cubic feet of dry gas was sold in 1936, an estimated 21,000,000,000 cubic feet were processed for gasoline extraction, and about 2,000,000,000 were used in field operations.

The gas line that carries gas from southeast New Mexico into Arizona was extended from Casa Grande to Ajo, Ariz.

Activity continued to be very limited in the northwestern part of the State; only three gas wells were completed. These were all in the Kutz Canyon field and had an open-flow capacity of about 4,000,000 cubic feet.

Sales of gas from the northwestern fields, which increased about 16 percent over 1935, were as follows: Blanco 23,944,000 cubic feet, Kutz Canyon 1,191,660,000, and Ute Dome 451,848,000. Of the gas produced from Ute Dome, 149,299,000 cubic feet were piped to Durango, Colo. It is estimated that 50 percent of the gas produced was used for industrial and the remainder for domestic and commercial purposes.

Delivery of a liquid propane-butane mixture from the Rattlesnake field to the Indian agency at Shiprock was begun in April 1936 through a line laid several years ago.

Two additional carbon dioxide wells were completed on the Wilcox dome, Torrance County, and one in the Bueyeros field, Harding County. In the Bueyeros field four wells were drilling at the end of the year, and two dry-ice plants were under construction. A dry-ice plant with a rated capacity of 30 tons per day has been operating for some time on the Wilcox dome gas.

New York.—Exploration for natural gas in New York in 1936 outside of the proved fields was continued at about the same rate as in 1935. Although fewer wells were drilled, total initial capacity increased, according to information supplied by C. A. Hartnagel, assistant State geologist. Operations conducted in 9 counties in the central and western parts of the State resulted in 43 completions, of which 23 were producers having a total open-flow capacity of 293,000,000 cubic feet per day.

Development was greatest in the new State Line pool in the towns of Alma and Willing, Allegany County. Fourteen wells were drilled to the Oriskany sand at depths of 4,600 to 4,900 feet. Of these, 12 were productive, having an average capacity of 24,000,000 cubic feet and accounting for 97 percent of the new gas developed in the State during the year.

Six other Oriskany-sand test wells were drilled in Allegany County and four in Steuben County, none of which resulted in commercial production. Four wells were completed as producers from the White Medina sandstone at about 3,600 feet in the town of Leon, Cattaraugus County. They had initial capacities of 3,200,000; 2,500,000; 900,000; and 50,000 cubic feet per day.

Several shallow wells, which produce gas from the Trenton limestone near Camden, Oneida County, were connected to serve that town during the year. Through extention of a line that runs southeastward from Binghamton, natural gas is now delivered to consumers in Rockland County, only 15 or 20 miles from New York City.

A 14-inch pipe line was laid from Potter County, Pa., to Rochester, a distance of 92 miles. Its chief customer will be a large industrial plant which has contracted for a maximum of 5,000,000,000 cubic feet annually.

Another pipe line which was completed during the year comprises 63 miles of 10-inch pipe and runs from Potter County, Pa., to a point near Arcade, Wyoming County, N. Y. From there one 8-inch line extends 43 miles westerly to Sheridan, Chautauqua County, and another 31 miles northerly to near East Lancaster, Erie County.

Ohio.—Drilling in Ohio increased approximately 10 percent during 1936, according to information in a report prepared by J. E. Schaefer, geologist, The East Ohio Gas Co., for the American Institute of Mining and Metallurgical Engineers. In the aggregate, 570 gas wells were completed.

The Clinton-sand area in central and eastern Ohio continued to be the most important source of gas and experienced the most active development, having 226 gas-well completions. A small pool was developed in Butler Township, Knox County, during 1936, in which 13 gas wells with an aggregate open-flow capacity of more than 15 million cubic feet a day were completed at a depth of about 3,000 feet. In lot 9 of Franklin Township, Tuscarawas County, a well was completed in the first Clinton sand at 4,354 feet. The initial open-flow capacity of the well after it was shot was 828,000 cubic feet and the closed pressure 1,325 pounds. A small gas well was completed in the red Clinton sand at 4,272 feet, in lot 4 of Wayne Township, Tuscarawas County. Clinton-sand completions accounted for 200,000,000 cubic feet, or more than two-thirds of the open-flow capacity developed in Ohio during 1936.

Twenty-nine small gas wells were drilled in the old Trenton lime field of northwestern Ohio. Six gas-well completions were recorded in the Newburg sand, which produces gas in Summit County and both oil and gas in Cuyahoga County.

Oriskany-sand development was unimportant in 1936. Two wells were added to the small Oriskany pool in Madison and Wayne Townships, Columbiana County, which had an initial capacity of 700,000 cubic feet each from about 4,450 feet and a closed pressure of 1,700 pounds. An Oriskany sand failure in sec. 13, Buffalo Township, Noble County, encountered dry sand at 4,128 to 4,145 feet, and one in sec. 9, Center Township, Morgan County, found salt water. Two efforts to extend production from a small Oriskany gas well in sec. 21, Sugar Creek Township, Stark County, resulted in dry holes through the Clinton sand.

In the Berea and shallower sands of eastern Ohio 279 gas wells were completed with a total capacity of 76,000,000 cubic feet per day. The Berea sand is the second most important productive formation in Ohio.

Twenty-one gas wells were completed in the Devonian shale and two in the Gordon sand during the year.

Oklahoma.—Developed gas reserves of Oklahoma were greatly increased in 1936. Information on field developments has been supplied by W. J. Armstrong, conservation officer, Oklahoma Corporation Commission.

During the year 126 gas wells were completed, a gain of 15 percent over 1935; of these, 11 were wildcat discoveries. Many oil wells in

the Oklahoma City field were plugged back to gas horizons in the Pennsylvanian and Simpson sands. The potential production of 130 gas wells in the field was 1,047,755,000 cubic feet of gas per day, as determined by the Bureau of Mines "back-pressure method." Much of this gas is used in gas-lift operations in the north part of the Oklahoma City field.

Oklahoma, with 18 gas-producing sands at various depths up to 6,500 feet, has one of the largest indicated gas reserves in the country. Perhaps the largest recently developed gas reserve is in the Fitts pool of Pontotoc County, where large volumes of gas occur in the Pennsylvanian above the oil-bearing horizons. The Cement field, Caddo County, which produces gas from five separate sands, is also an important reserve. Another large potential source of gas is in Texas County between the Hugoton field in Kansas and the Texas Panhandle field.

Records of the Oklahoma Tax Commission show that 111,607,000,000 cubic feet of gas were produced and sold from dry-gas wells in 1936 and that 267,016,434,000 cubic feet of casinghead gas were processed for extraction of gasoline.

The gas-repressuring unit operation in the South Burbank oil pool, Osage County, continued with conspicuous success during the year, and a similar project was begun in the Keokuk Falls pool, Seminole County, in the summer of 1936.

Natural-gas pipe-line construction was limited to small additions to existing systems. Twenty-five miles of 8-inch line were laid from Red Oak to Poteau, Okla., and two lines about 10 miles in length were laid to the Cement pool from the Chickasha gas field.

Pennsylvania.—Drilling activity in Pennsylvania in 1936 increased somewhat over that in 1935. Data on the northwestern and middle parts of the State are taken from a report compiled for the American Institute of Mining and Metallurgical Engineers by J. G. Montgomery, Jr., superintendent and chief geologist, United Natural Gas Co.

Shallow-sand development was confined largely to productive areas, and no important new shallow-gas pools were discovered. The search for gas in the Oriskany formation continued at about the same rate as in other recent years. A well in Kinzua Township, Warren County, found gas in this horizon, but subsequently salt water appeared and at the end of the year the value of the discovery was still problematical. Another wildcat discovery struck 500,000 cubic feet of gas in the Oriskany formation in South Union Township, Fayette County. Although the gas was found last August, the well had not been completed at the end of 1936 because of drilling difficulties. A well in Butler County found salt water in the Oriskany. Other test wells were drilled in this formation in Fayette, Washington, Lawrence, Beaver, Crawford, Potter, and Tioga Counties.

Gas production from the shallower sands in 1936 does not appear to have changed greatly from that in 1935. The output of the Oriskany fields, however, increased almost 8,000,000,000 cubic feet to 37,700,000,000, owing to a large increase in output in the Ellisburg field, Potter County, and smaller increases in Sabinsville, Tioga County, and Harrison, Potter County, which more than offset declines in the Hebron, Potter County, and Farmington, Tioga County, fields. In the first 3 fields 23 new gas wells were brought in during the year.

New outlets for gas from the Oriskany formation were furnished by laying lines from the Hebron field to Clarion County, Pa., and from the Harrison field to northwestern New York State. A 14-inch line from the State Line field in Genesee Township, Potter County, Pa., to Rochester, N. Y., was placed in service in early 1937.

South Dakota.—The cities of Pierre and Fort Pierre continued to produce and consume the only natural gas produced commercially in South Dakota. E. P. Rothrock, State geologist, states that a show of gas was reported from a depth of 3,660 feet in a well at the Newell Experiment Farm.

Texas.—Gas-well completions in Texas numbered 388 in 1936, an increase of 110 over the preceding year. The largest gain was in the Panhandle field where there were 161 new gas wells, representing a 100-percent increase over 1935, in spite of a falling off in total drilling in that district. General drilling increased in all other Texas districts except the North Texas, where 166 (11 percent) fewer wells were drilled, and the East Texas field.

Gas production and disposition figures are taken from reports compiled by the Engineering Department, Railroad Commission of Texas.

The total dry-gas production of Texas in 1936 was reported as 575,275,066,000 cubic feet, of which 398,439,953,000 were "sweet" gas and 176,835,113,000 "sour" gas, which has a comparatively high hydrogen sulphide content. Production of 267,556,475,000 cubic feet of casinghead gas increased the total natural gas produced in the State to the tremendous quantity of 842,831,541,000 cubic feet. About 670,000,000,000 cubic feet of gas were processed for extraction of gasoline, and 216,000,000,000 cubic feet were burned in the manufacture of carbon black. The amount of residue gas blown to the air was greatly reduced.

A number of new gas areas were discovered during the year. The first production in Collingsworth County in the Panhandle district resulted from a well drilled on the Tinsley ranch, sec. 8, block 13, H. & G. N. survey. It produced about 2,000,000 cubic feet initial from 1,880 feet. In Hamilton County, North-Central Texas district, a "wildcat" on the L. T. Rhea farm, David Cook survey, was completed for 12,000,000 cubic feet from the Marble Falls limestone at 2,455 feet. A second well of similar size was drilled before the end of the year.

In south Texas drilling was very active, and several new gas fields were found. In southeastern McMullen County a gas well in sec. 86 on the Rhode ranch was completed in the Whitsett (upper Jackson) sand at a depth of 1,810 to 1,822 feet. Three more wells drilled in the area in 1936 proved about 1,000 acres for gas production. The Wood field in southern Starr County was opened in July by discovery of gas in the Frio sand at 963 to 975 feet. The Maetz gas area in Goliad County and the South Cole gas field were also discovered in 1936.

Gulf coast operations made large additions to known gas reserves, most of which, however, were associated with oil. In Harris County, northeast of the city limits of Houston, the Candelaria No. 1 blew out after 1 foot of sand was penetrated at 8,101 feet. After being brought under control, the well produced large volumes of gas with some high-grade oil. The shut-in pressure was 4,800 pounds, the highest ever recorded on the Gulf coast. The Lockridge gas field, Brazoria County, was opened by the Fairfield No. 1 well, which produced from 6,257 feet after being plugged back from 8,698 feet. Other gas discoveries

include Seabreeze, Chambers County, and three areas in Wharton County.

In eastern Texas the development of the Rodessa field was the outstanding feature of 1936. About 170 oil wells were drilled from which large quantities of gas were taken by pipe lines. Gas production in the Long Lake and Cayuga fields increased from about 3 billion to more than 10 billion cubic feet. A deeper gas horizon was found in the Cayuga field when a test well produced 12,000,000 feet of wet gas with distillate from the Trinity formation. New sources of gas from the Glen Rose formation were found in the Joaquin field, Shelby County, and 6 miles east of Carthage, Panola County. A 50,000,000-cubic foot well in the Woodbine sand was the discovery well of the Grapeland field in Houston County.

Demand for gas from the Panhandle field increased substantially in 1936 over 1935. The capacity of several major trunk lines leading north and east from the district was increased by laying new pipe and enlarging compressor installations. Improved conditions in the carbon-black and natural-gasoline industries stimulated construction of new plants in the field for manufacture of these products.

Several gas pipe lines were laid in 1936, and 122 miles of 10-inch pipe to serve industrial plants were under construction at the close of the year from the Tomball field to Houston, Port Arthur, and intermediate points. The capacity of the line will be about 60,000,000 cubic feet per day. In the Rio Grande Valley, lines were laid to connect McAllen with a Hidalgo Gas Co. line and to bring gas from the Mercedes and Mestanas fields, Hidalgo County, to Rio Grande Valley towns. A large system of lines was built in the Rodessa area to gather and market the new supplies of casinghead gas developed. Thirty miles of 6-inch line were laid from the Johnson pool, Foard County, to an electric power plant near Quanah, Hardeman County. Lines were built to furnish gas to the towns of Talco, Titus County, and Athens, Anderson County.

Utah.—There were no significant changes in the natural-gas industry in Utah during 1936, according to a report by E. W. Henderson, district engineer, U. S. Geological Survey, Salt Lake City, Utah. Only one gas well was completed; it was in the Clay Basin field, Daggett County, and had an open-flow capacity of 16,000,000 cubic feet and a closed pressure of 1,400 pounds per square inch from sands in the Dakota formation at 5,738 to 5,782 feet.

All wells in the Clay Basin field remained shut in during the year except for a short period when 44,842,000 cubic feet of gas were produced and used in the field for development purposes. The two producing wells in the Ashley Valley field, Uintah County, produced 51,476,280 cubic feet, all of which was used for domestic purposes. Two gas wells in the Cisco Dome field, Grand County, were abandoned, and the remaining eight wells continued to be shut in. The one gas well on the Last Chance structure, Emery County, did not produce during the year.

The inaccessibility of markets and the abundance of cheap, locally mined coal have discouraged development of natural-gas reserves in Utah.

Washington.—The natural-gas situation in Washington during 1936 remained much the same as in 1935, according to a report furnished by Harold E. Culver, supervisor of geology, Washington Department of Conservation.

Commercial production continued to be virtually limited to the output of the Rattlesnake Hills field, Benton County. The 15 active wells in this field supplied 183,177,000 cubic feet of gas to seven towns in the Yakima Valley, where it was used for domestic and industrial purposes. The compressor plant, which maintains a vacuum on the wells in the field, was enlarged during the year as a means of stimulating production. Work was resumed on a deep test well in the hope of discovering a new source of gas in the sediments which are thought to underlie the basalt flows which now supply gas.

Progress was reported on test wells in Chelan, Grant, Grays Harbor, Jefferson, King, Snohomish, and Yakima Counties and in the area north of Bellingham, Whatcom County, where small quantities of gas are put to domestic use; however, no new discoveries were made.

The production of carbon dioxide gas from the springs and shallow wells near Klickitat, in southern Washington, was increased in 1936 by drilling several new wells. The capacity of the dry-ice plant which utilizes this gas was increased from 3 to 5 tons per day, and 1,085,551 pounds of the product were sold during the year.

West Virginia.—There was a marked increase in natural-gas activity in West Virginia during 1936 in response to the pressure of larger market demand. The following information is taken from a report compiled by David B. Reger, consulting geologist, Morgantown, W. Va.

Although no new fields were discovered, large extensions of proved territory were developed, particularly in the Oriskany-sand area of Kanawha County. Forty-five Oriskany-sand gas wells were completed with a total initial capacity in excess of 200,000,000 cubic feet per day. Their open-flow capacity ranged from 100,000 to 15,000,000 cubic feet and their closed pressure from 1,200 to 1,900 pounds. The productive area, of which approximately 11,000 acres are regarded as proved, extends about 18 miles north and south and 6 miles in maximum width in the Elk, Loudon, Malden, and Poca districts. The Middle Devonian brown shale has been found productive of gas in wider areas of Boone, Lincoln, Putnam, and Kanawha Counties.

The number of gas wells completed increased only moderately in 1936 (to 461 from 417 in 1935), but the open-flow capacity of the new wells more than doubled (to 554,119,000 cubic feet). It is estimated that at the close of the year about 100 more wells were drilling than at the close of the previous year.

From the gas standpoint, Cabell and Kanawha Counties were outstandingly active, contributing over 60 percent of the newly developed capacity. The next most active counties were Roane, Ritchie, Calhoun, Logan, and Boone.

In addition to routine extensions to gas gathering systems, one major line was constructed in 1936. It consists of 95 miles of 12¾-inch pipe extending from a compressor station near Clendenin, Kanawha County, northward to Hastings, Wetzel County. A 15-mile feeder line of the same size was built to join the main line at Burnt House, Ritchie County. The gas is carried into Ohio and Pennsylvania. The rated capacity of the line is about 40,000,000 cubic feet per day at 300 pounds. The pipe is of seamless steel, and all joints are electrically welded. A calcium chloride brine dehydrator to free the gas of moisture was installed at the compressor-station end of the line.

153336—37——69

Wyoming.—Only four gas wells were drilled in Wyoming during 1936, but two of these resulted in the discovery of new gas reserves, as described in the following abstract of a report compiled by H. J. Duncan, supervisor, United States Geological Survey, Casper, Wyo.

The Hintze No. 1 well in sec. 18, T. 22 N., R. 78 W., on the East Allen Lake structure in Carbon County developed approximately 11,000,000 cubic feet of gas per day from the Sundance sand at 2,044 to 2,084 feet. The discovery had not been completed at the end of the year because the owners of the well planned to deepen it to search for oil production. It is located within a few miles of the Allen Lake-Laramie gas line.

The other discovery was made in the Shawnee area, Converse County, when the Salisbury No. 1 well in sec. 27, T. 32 N., R. 69 W., produced approximately 7,000,000 cubic feet of gas initially at a total depth of 580 feet. At present there is no other market for the gas except for fuel in drilling operations.

An additional supply of gas was produced with oil from the basal Sundance sand in the Lance Creek field, Niobrara County.

It is estimated that 34,581,000,000 cubic feet of gas were produced in Wyoming in 1936, of which about 10,560,000,000 were casinghead and the remainder was dry gas. The Salt Creek field was by far the largest source, with a production of 10,155,890,000 cubic feet of casinghead gas (about the same as in 1935). This gas was put through gasoline plants and disposed of as follows: 7,029,526,000 cubic feet were returned to the oil sands for gas-drive purposes, 1,368,351,000 were used in field operations and in generation of electricity, 824,670,-000 were consumed by gasoline plants and compressor stations, and 385,767,000 were used for domestic and commercial purposes. Production in 1936 of 1 billion to 3½ billion cubic feet of gas each was reported for the South Baxter Basin, Big Sand Draw, Lance Creek, Wertz, North Baxter Basin, Elk Basin, Little Buffalo Basin, and Mahoney fields, which are named in order of their importance.

It is roughly estimated that 14 billion cubic feet of gas produced in Wyoming were used for industrial and commercial purposes, 7½ billion for domestic purposes, 2½ billion for field operations, and 2½ billion for the manufacture of carbon black.

Very little gas was wasted in the State except that from the Stock Oil Co. Allen No. 1 well in lot 52, T. 56 N., R. 97 W., Garland field, Big Horn County, which blew out of control on January 19, 1936, and remained out of control through December 1936. It is estimated that 16,000,000,000 cubic feet of gas were dissipated from this operation.

No trunk pipe lines were constructed during 1936. A new gasoline plant capable of processing 5,000,000 cubic feet of gas per day was erected in the Lance Creek field. About 1.7 gallons of gasoline are obtained per thousand cubic feet and the residue is used for field operations and in the carbon-black plant, which consumed an estimated 2,500,000,000 cubic feet during 1936. There is no other market for gas from this field.

CONSUMPTION

The consumption of natural gas in the United States is less than 1 percent under the marketed production, as the excess of exports over imports is relatively small and stocks are negligible. The largest item in the consumption of natural gas is that representing field use;

this accounts for about 30 percent of the total. The next most important uses are "Other industrial" and domestic, which comprise about 25 and 15 percent, respectively. Natural gas consumed for domestic purposes has the highest value; the average for 1936 was estimated as 72.8 cents per thousand cubic feet. The lowest values are in field use; this average for 1936 was about 5 cents per thousand cubic feet.

Data on the number of consumers of natural gas in 1936 were not obtained, but the over-all totals may be estimated as 7,500,000 domestic, 650,000 commercial, and 40,000 industrial consumers. These totals include about 2,500,000 domestic and commercial consumers who used mixed gas containing various proportions of natural gas.

Natural gas consumed in the United States, 1925–35

Year	Domestic and commercial consumption							
	Consumers (thousands)			Billions of cubic feet			Average number of M cubic feet used per domestic and commercial consumer	Average value at points of consumption per M cubic feet (cents)
	Domestic	Commercial	Total	Domestic	Commercial	Total		
1925	[1] 3,508	(1)	3,508	[1] 272	(1)	272	77.6	56.0
1926	[1] 3,731	(1)	3,731	[1] 289	(1)	289	77.5	58.4
1927	[1] 3,984	(1)	3,984	[1] 296	(1)	296	74.3	60.8
1928	[1] 4,344	(1)	4,344	[1] 321	(1)	321	73.9	62.0
1929	[1] 5,098	(1)	5,098	[1] 360	(1)	360	70.6	62.0
1930	[2] 5,035	[2] 413	[2] 5,448	296	81	377	69.1	63.5
1931	[2] 6,443	[2] 518	[2] 6,961	294	87	381	54.7	65.5
1932	[2] 6,506	[2] 531	[2] 7,037	299	87	386	54.8	69.3
1933	[2] 6,691	[2] 541	[2] 7,232	283	86	369	51.0	68.4
1934	[2] 6,984	[2] 582	[2] 7,566	288	91	379	50.2	68.6
1935	[2] 7,391	[2] 613	[2] 8,004	314	100	414	51.7	68.5

Year	Industrial consumption								Total consumption	
	Billions of cubic feet							Average value at points of consumption per M cubic feet (cents)	Billions of cubic feet	Average value a points of consumption per M cubic feet (cents)
	Field	Carbon black	Petroleum refineries	Electric public-utility power plants [3]	Portland cement plants [4]	Other industrial	Total industrial			
1925	424	140	88	46	(5)	218	916	12.3	1,188	22.3
1926	478	131	122	53	(5)	240	1,024	12.8	1,313	22.9
1927	549	144	123	63	24	246	1,149	12.0	1,445	22.0
1928	574	175	115	77	31	275	1,247	13.2	1,568	23.2
1929	705	261	104	113	41	333	1,557	12.2	1,917	21.5
1930	723	267	99	120	41	315	1,565	11.3	1,942	21.4
1931	571	196	76	138	31	291	1,303	10.9	1,684	23.3
1932	529	168	68	107	21	275	1,168	10.0	1,554	24.7
1933	491	190	66	103	22	312	1,184	9.8	1,553	23.7
1934	555	230	80	128	27	366	1,386	9.7	1,765	22.3
1935	580	242	80	125	27	442	1,496	9.7	1,910	22.4

[1] Domestic includes commercial; separate figures not available.
[2] Includes consumers served with mixed gas.
[3] U. S. Geol. Survey.
[4] Bagley, B. W., chapters on Cement, in Minerals Yearbook and Statistical Appendix to Minerals Yearbook.
[5] Included under "Other industrial"; separate figures not available.

Natural gas consumed in the United States, 1924–35, by States, in millions of cubic feet

State	1924	1925	1926	1927	1928	1929
Alaska	(1)	(1)	(1)	(1)	(1)	(1)
Arkansas	44,595	51,543	52,630	40,916	37,763	39,758
California	189,692	187,789	204,915	212,364	246,215	342,214
Colorado	48	574	504	1,544	6,347	14,362
Illinois	4,072	4,165	3,808	3,741	3,051	3,139
Indiana	2,377	1,786	1,854	2,166	2,259	2,365
Iowa	(1)	(1)	----------	----------	----------	(1)
Kansas	40,528	48,684	61,142	66,618	72,671	75,476
Kentucky	21,514	18,601	18,126	16,694	15,802	19,444
Louisiana	163,469	148,000	148,886	170,310	188,755	200,777
Maryland	679	(1)	(1)	(1)	(1)	(1)
Michigan	(1)	(1)	(1)	1	469	4,526
Mississippi	----------	----------	----------	(1)	(1)	574
Missouri	5,394	5,372	5,819	6,584	9,766	15,078
Montana	2,228	2,608	3,295	5,455	7,265	9,332
New Mexico	----------	(1)	921	1,019	854	1,021
New York	16,506	16,503	17,864	16,175	17,918	18,192
North Dakota	(1)	(1)	(1)	2	(1)	(1)
Ohio	111,353	111,969	115,719	112,603	122,484	126,631
Oklahoma	183,451	209,458	244,993	286,485	285,333	329,295
Pennsylvania	123,932	119,475	125,836	121,982	116,150	122,876
South Dakota	3	4	10	92	214	1,717
Tennessee	1	9	11	9	(1)	5,395
Texas	107,447	142,485	187,341	269,944	318,718	465,526
Utah	----------	----------	----------	(1)	1,105	1,539
Washington	----------	----------	----------	----------	----------	(1)
West Virginia	79,240	74,250	72,784	66,200	67,272	73,856
Wyoming	44,879	44,427	45,605	42,559	46,549	43,500
Other States	74	737	790	1,781	1,019	858
Total	1,141,482	1,188,439	1,312,853	1,445,244	1,567,979	1,917,451

State	1930	1931	1932	1933	1934	1935
Alabama	1,155	8,458	5,827	7,510	7,932	10,563
Alaska	(1)	(2)	(2)	19	----------	----------
Arizona	----------	(2 3)	2,274	2,513	4,729	5,603
Arkansas	38,231	32,278	25,330	22,775	25,075	26,476
California	334,789	305,930	263,484	259,799	268,122	284,109
Colorado	16,642	16,892	16,409	15,862	16,449	17,233
District of Columbia	----------	[3] 1,388	1,688	2,046	2,640	2,707
Florida	----------	[3] 357	618	494	554	692
Georgia	1,497	4,904	3,947	4,450	5,357	8,082
Illinois	9,602	14,050	29,432	33,341	45,084	57,319
Indiana	2,515	4,695	11,651	5,996	12,864	15,613
Iowa	(1)	3,522	7,533	11,408	16,636	19,077
Kansas	75,635	65,609	56,965	57,032	65,599	72,806
Kentucky	15,966	15,533	13,698	13,222	14,106	15,826
Louisiana	184,096	131,986	113,215	115,800	137,413	151,934
Maryland	(1)	679	639	667	752	784
Michigan	2,075	472	968	1,528	2,789	4,203
Minnesota	----------	(3 4)	(4)	3,547	7,125	10,579
Mississippi	1,735	4,370	5,762	5,818	7,219	8,765
Missouri	26,122	24,261	25,310	27,584	29,792	33,060
Montana	[5] 8,065	[5] 8,359	[5] 11,100	[5] 12,222	[5] 12,444	[5] 16,832
Nebraska	1,098	4,817	8,661	10,293	12,789	14,310
New Mexico	3,935	12,443	11,880	13,400	15,625	18,419
New York	18,991	16,956	16,724	19,912	31,209	35,705
North Dakota	(1)	[4] 885	[4] 2,133	1,020	1,112	1,382
Ohio	125,816	107,460	94,414	92,762	94,998	105,896
Oklahoma	320,851	248,949	246,741	242,494	249,721	258,598
Pennsylvania	108,218	92,629	76,935	73,627	87,474	91,601
South Dakota	2,905	2,803	2,776	3,264	3,901	4,656
Tennessee	7,334	7,623	7,683	7,369	8,062	9,479
Texas	526,160	447,632	414,644	412,428	501,047	525,697
Utah	4,045	[2] 6,497	[2] 5,721	5,853	6,776	8,747
Virginia	----------	[3] 75	143	213	292	343
Washington	(1)	(2)	(2)	111	104	138
West Virginia	62,882	55,115	46,281	46,933	52,353	53,763
Wyoming	40,219	36,622	23,749	20,087	16,844	18,904
Other States	1,065	----------	----------	----------	----------	----------
Total	1,941,644	1,684,249	1,554,335	1,553,399	1,764,988	1,909,901

[1] Included under "Other States."
[2] 1931: Utah includes Alaska, Arizona, and Washington; 1932: Utah includes Alaska and Washington.
[3] Service inaugurated in 1931, hence figures represent operations for only part of year.
[4] North Dakota includes Minnesota.
[5] Includes natural gas piped from Canada.

Treated for natural gasoline.—Until 1935 the trend in the average yield of natural gasoline per thousand cubic feet of gas processed was downward, owing to the treatment of increasingly large volumes of lean natural gas in the Texas Panhandle field and to progressively greater stabilization. However, the average yield increased in 1935 and 1936 because of the curtailing of operations at the "stripper" plants in the Panhandle and the rapid growth in natural-gasoline production in the east Texas field, a high-yield area, and in 1936 because of the growth in importance of production at Rodessa, where the casinghead gas is also relatively rich.

Natural gas treated at natural-gasoline plants in the United States, 1926–35, by States

[Millions of cubic feet]

State	1926	1927	1928	1929	1930
Alaska	25	15	20	27	30
Arkansas	20,903	20,566	13,030	11,644	11,624
California	284,365	332,676	380,059	617,648	627,733
Colorado	390	1,455	3,498	1,880	1,926
Illinois	3,674	3,582	2,999	2,760	2,721
Indiana	----------	----------	----------	2	1
Kansas	30,801	28,906	33,091	47,565	56,582
Kentucky	26,521	27,994	25,801	23,479	25,432
Louisiana	111,537	118,191	129,513	153,370	181,582
New Mexico	884	998	731	555	2,381
New York	500	539	411	598	643
Ohio	45,533	42,623	49,572	43,901	36,465
Oklahoma	235,157	262,703	275,961	314,649	330,291
Pennsylvania	63,819	47,424	49,542	50,789	41,848
Texas	181,243	265,699	309,769	479,543	584,974
West Virginia	166,135	152,297	164,120	177,606	155,065
Wyoming	34,813	35,580	35,317	33,278	29,480
	1,206,300	1,341,248	1,473,434	1,959,294	2,088,778
Percent of total consumption	92	93	94	[1] 102	[1] 108

State	1931	1932	1933	1934	1935
Alaska	25	19	20	----------	----------
Arkansas	8,788	6,188	4,949	3,250	3,371
California	470,096	345,085	326,016	325,629	310,016
Colorado	824	627	547	511	222
Illinois	2,106	1,924	1,701	1,512	1,076
Indiana	[2]	[2]	----------	----------	----------
Kansas	54,861	46,290	52,939	69,859	87,669
Kentucky	23,281	23,948	22,244	21,704	29,772
Louisiana	134,238	106,239	80,891	70,534	81,868
Michigan	----------	----------	444	410	1,755
Montana	----------	----------	4,358	4,114	6,382
New Mexico	12,590	9,230	10,399	11,904	11,786
New York	487	430	406	375	27
Ohio	25,666	24,613	21,901	25,100	29,622
Oklahoma	285,029	315,727	351,989	299,183	260,757
Pennsylvania	36,414	28,627	31,810	29,346	33,348
Texas	579,327	467,295	532,148	787,078	828,570
West Virginia	128,670	100,171	90,072	108,097	118,789
Wyoming	27,717	23,343	18,630	17,566	16,970
	1,790,119	1,499,756	1,551,464	1,776,172	1,822,000
Percent of total consumption	[1] 106	96	100	[1] 101	95

[1] Exceeds 100 percent, as part of the natural gas treated for natural gasoline is blown to the air and not included in total consumption.
[2] Less than 500,000 cubic feet.

These events apparently account for the reversal in the trend of gasoline recovery. The low average of 0.86 gallon per thousand cubic feet in 1934 was increased to 0.91 gallon in 1935, and probably a moderate increase carried over into 1936. It is estimated that 1,900,000,000,000 cubic feet of natural gas were treated for the extraction of gasoline in 1936, an increase of about 80,000,000,000 cubic feet over 1935. The total so treated was about 88 percent of the total consumption of natural gas in the United States in 1936, compared with 95 percent in 1935 and 101 percent in 1934. This decline in ratio results primarily from the progressive reduction in the wastage of residue gas.

The accompanying table on natural gas treated at natural-gasoline plants by States indicates the conspicuous growth of the natural-gasoline industry in Texas during the past 10 years. The quantity of gas processed in California in 1929, 1930, and 1931 increased substantially, but aside from this period such operations in California and Oklahoma have remained relatively stable. Among less important States in the industry, West Virginia and Louisiana have treated gradually less gas, and Kansas has treated more, particularly since 1932. Quantities of gas treated in the United States have increased annually since the low point of the depression in 1932 but are still less than in 1929–31.

Domestic and commercial.—The volume of gas used for domestic purposes increased about 10 percent in 1936 to an estimated total of 345,000,000,000 cubic feet, compared with 313,498,000,000 cubic feet in 1935. Its value at points of consumption increased about 7 percent to $251,000,000. An increase in the quantity of gas consumed by the average domestic customer probably reduced somewhat the average unit price received by gas companies, as most price schedules offer advantageous rates on gas used in excess of a prescribed minimum. Commercial demand is estimated to have expanded almost 13 percent over 1935—to 113,000,000,000 cubic feet having a value of about $55,000,000. Sales of gas to domestic and commercial users combined accounted for 64 percent of the total revenue from natural gas in 1936 but represented only 21 percent of the total volume consumed.

Domestic and commercial consumption of natural gas in the United States in 1935, by States [1]

State	Domestic				Commercial				Total			
	Consumers	M cubic feet	Value at points of consumption		Consumers	M cubic feet	Value at points of consumption		Consumers	M cubic feet	Value at points of consumption	
			Total	Average (cents)			Total	Average (cents)			Total	Average (cents)
Alabama	23,310	860,000	$1,160,000	134.9	2,810	489,000	$252,000	51.5	26,120	1,349,000	$1,412,000	104.7
Arizona	20,410	361,000	756,000	209.4	1,930	462,000	264,000	57.1	22,340	823,300	1,020,000	123.9
Arkansas	58,510	4,796,000	2,677,000	55.8	10,290	2,591,000	974,000	37.6	68,800	7,387,000	3,651,000	49.4
California	1,373,220	53,101,000	49,802,000	93.8	83,270	15,958,000	9,427,000	59.1	1,456,490	69,059,000	59,229,000	85.8
Colorado	86,110	3,854,000	3,266,000	84.7	7,830	1,145,000	711,000	62.1	93,940	4,999,000	3,977,000	79.6
District of Columbia	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Florida	2,980	71,000	118,000	166.2	280	34,000	26,000	76.5	3,260	105,000	144,000	137.1
Georgia	66,400	2,571,000	2,664,000	103.6	4,410	1,568,000	601,000	38.3	70,810	4,139,000	3,265,000	78.9
Illinois	1,086,330	17,379,000	22,789,000	131.1	60,940	3,431,000	3,589,000	104.6	1,147,270	20,810,000	26,378,000	126.8
Indiana	166,750	1,739,000	1,848,000	106.3	8,830	249,000	237,000	95.2	175,580	1,988,000	2,085,000	104.9
Iowa	104,060	3,021,000	3,483,000	115.3	7,350	1,225,000	728,000	59.4	111,410	4,246,000	4,211,000	99.2
Kansas	182,870	13,060,000	8,141,000	62.3	19,930	6,877,000	2,336,000	34.0	202,800	19,937,000	10,477,000	52.6
Kentucky	148,770	7,584,000	4,311,000	56.8	17,340	1,888,000	973,000	51.5	166,110	9,472,000	5,284,000	55.8
Louisiana	140,540	6,842,000	4,860,000	71.0	17,140	4,171,000	1,551,000	37.2	157,680	11,013,000	6,411,000	58.2
Maryland	[2] 170,510	[2] 3,012,000	[2] 2,506,000	[2] 83.2	[2] 8,610	[2] 432,000	[2] 328,000	[2] 75.9	[2] 179,120	[2] 3,444,000	[2] 2,834,000	[2] 82.3
Michigan	40,660	1,359,000	1,250,000	92.0	2,070	251,000	144,000	57.4	42,730	1,610,000	1,394,000	86.6
Minnesota	126,090	3,064,000	3,256,000	106.3	6,430	1,226,000	513,000	41.8	132,520	4,290,000	3,769,000	87.9
Mississippi	28,800	1,929,000	1,343,000	69.6	5,130	1,279,000	420,000	32.8	33,930	3,208,000	1,763,000	55.0
Missouri	346,400	9,625,000	8,636,000	89.7	32,040	3,371,000	2,214,000	65.7	378,440	12,996,000	10,850,000	83.5
Montana	29,310	4,580,000	2,216,000	48.4	4,340	2,984,000	883,000	29.6	33,650	7,564,000	3,099,000	41.0
Nebraska	104,610	4,003,000	3,117,000	77.9	5,580	912,000	548,000	60.1	110,190	4,915,000	3,665,000	74.6
New Mexico	12,900	1,013,000	742,000	73.2	1,160	648,000	214,000	33.0	14,060	1,661,000	956,000	57.6
New York	364,970	14,180,000	11,742,000	82.8	31,260	1,971,000	1,565,000	79.4	396,230	16,151,000	13,307,000	82.4
North Dakota	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Ohio	1,109,030	54,675,000	32,724,000	59.9	107,200	11,032,000	6,311,000	57.2	1,216,230	65,707,000	39,035,000	59.4
Oklahoma	212,020	18,114,000	8,153,000	45.0	28,190	7,022,000	2,345,000	33.4	240,210	25,136,000	10,498,000	41.8
Pennsylvania	619,760	32,847,000	20,413,000	62.1	53,760	7,209,000	4,045,000	56.1	673,520	40,056,000	24,458,000	61.1
South Dakota	12,380	880,000	707,000	80.3	1,460	986,000	388,000	39.4	13,840	1,866,000	1,095,000	58.7
Tennessee	36,910	1,817,000	1,651,000	90.9	4,760	1,536,000	615,000	40.0	41,670	3,353,000	2,266,000	67.6
Texas	511,380	25,835,000	21,044,000	81.5	56,930	13,081,000	5,095,000	38.9	568,310	38,916,000	26,139,000	67.2
Utah	[3] 24,950	[3] 2,216,000	[3] 1,432,000	[3] 64.6	[3] 1,290	[3] 1,018,000	[3] 367,000	[3] 36.1	[3] 26,240	[3] 3,234,000	[3] 1,799,000	[3] 55.6
Virginia	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Washington	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
West Virginia	162,730	16,404,000	6,022,000	36.7	18,400	4,312,000	1,470,000	34.1	181,130	20,716,000	7,492,000	36.2
Wyoming	17,020	2,706,000	1,111,000	41.1	2,000	829,000	252,000	30.4	19,020	3,535,000	1,363,000	38.6
Total, 1935	7,390,690	313,498,000	233,940,000	74.6	612,960	100,187,000	49,386,000	49.3	8,003,650	413,685,000	283,326,000	68.5
1934	6,983,410	288,236,000	215,029,000	74.6	582,140	91,261,000	45,287,000	49.6	7,565,550	379,497,000	260,316,000	68.6

[1] Includes natural gas used with manufactured gas. [2] Maryland includes District of Columbia and Virginia. [3] Utah includes North Dakota and Washington.

Field.—Natural gas used in field operations, which include the generation of power for drilling, reconditioning, and pumping wells and other purposes, is thought to have increased about 10 percent over 1935 to 640,000,000,000 cubic feet in 1936. Natural gas used in the drilling of wells for oil and gas, a major field use, increased 19 percent in 1936, and other field uses showed similar gains. Power equipment used in oil fields for compressing gas and for pumping oil and water probably has been utilizing progressively larger amounts of natural gas in recent years.

Carbon black.—The consumption of natural gas by the carbon-black industry reached new high levels in 1936 in response to a record-breaking demand. The total quantity of gas burned at carbon-black plants in 1936 was 283,421,000,000 cubic feet—17 percent more than in 1935 and almost 17,000,000,000 cubic feet more than in 1930, the previous record year.

Petroleum refineries.—From 1927 to 1933 the use of natural gas as a refinery fuel declined steadily, as many companies found it economical to use their own still gases as fuel rather than to purchase natural gas. In 1934 and 1935, however, the trend was the other way with the growing realization that still gases, or some fractions of them, were more valuable as processing material in motor-fuel manufacture. In 1935 natural gas burned as fuel at petroleum refineries totaled 80,175,000,000 cubic feet; probably the total in 1936 was somewhat larger, as crude runs to stills increased materially in 1936 over 1935 and prices of competing fuels were generally higher.

Electric public-utility power plants.—Public-utility power plants increased their use of natural gas as fuel in generating power to 156,080,000,000 cubic feet in 1936, the largest consumption in recent years and almost 25 percent higher than in 1935. This pronounced increase, which was proportionately greater than the rise in electric-power generation in the country, indicates a growing preference for natural gas instead of fuel oil and coal.

Portland-cement plants.—The portland-cement industry, which has shared in the recent expansion in industrial activity, consumed an estimated total of 36,923,000,000 cubic feet of natural gas in 1936, a gain of 38 percent over 1935 but less than the record levels of 1929 and 1930.

Other industrial.—The trend in sales of natural gas for industrial purposes, other than those mentioned, is important chiefly as it throws light on the competitive fuel situation in the manufacturing industries and the degree to which the interstate systems have augmented their domestic and commercial business with off-peak industrial loads. Indications are that sales of natural gas for miscellaneous industrial purposes increased about 16 percent in 1936 over 1935. As this gain exceeded the percentage increase in total consumption and probably was greater than the increase in total B. t. u. consumption of the enterprises using natural gas, it may be assumed that natural gas maintained its competitive position as an industrial fuel. Moreover, this business probably was more profitable in 1936 than for several years, as the volume of sales for preferential uses has grown to a point where the temptation to sell wholly on a volume basis has been virtually removed.

Industrial consumption of natural gas in the United States in 1935, by States and uses

State	Field (drilling, pumping, and operating gasoline recovery plants)		Manufacture of carbon black			Fuel at petroleum refineries, electric public-utility power plants, portland cement plants, and other industrial							Total industrial		
	M cubic feet (estimated)	Value at points of consumption (estimated)	M cubic feet	Value at points of consumption		M cubic feet					Value at points of consumption		M cubic feet	Value at points of consumption	
				Total	Average (cents)	Petroleum refineries	Electric public-utility power plants	Portland cement plants	Other industrial	Total	Total	Average (cents)		Total	Average (cents)
Alabama								(1)	[1] 9,214,000	9,214,000	$1,469,000	15.9	9,214,000	$1,469,000	15.9
Arizona							473,000		4,307,000	4,780,000	943,000	19.7	4,780,000	943,000	19.7
Arkansas	5,348,000	$490,000				2,331,000	1,063,000	(1)	[1] 10,347,000	13,741,000	1,871,000	13.6	19,089,000	2,361,000	12.4
California	110,050,000	7,806,000				25,010,000	18,041,000	(1)	[1] 61,949,000	105,000,000	14,450,000	13.8	215,050,000	22,256,000	10.3
Colorado	233,000	10,000					406,000	(1)	[1] 11,595,000	12,001,000	1,672,000	13.9	12,234,000	1,682,000	13.7
District of Columbia									(2)	(2)	(2)	(2)	(2)	(2)	(2)
Florida									587,000	587,000	86,000	14.7	587,000	86,000	14.7
Georgia							1,352,000		2,591,000	3,943,000	636,000	16.1	3,943,000	636,000	16.1
Illinois	1,414,000	108,000				168,000	41,000		34,886,000	35,095,000	6,919,000	19.7	36,509,000	7,027,000	19.2
Indiana	100,000	12,000					7,561,000		5,964,000	13,525,000	2,701,000	20.0	13,625,000	2,713,000	19.9
Iowa							4,502,000	(1)	[1] 10,329,000	14,831,000	2,205,000	14.9	14,831,000	2,205,000	14.9
Kansas	16,394,000	1,219,000				1,747,000	13,457,000	4,301,000	16,970,000	36,475,000	5,060,000	13.9	52,869,000	6,279,000	11.9
Kentucky	776,000	99,000							5,578,000	5,578,000	1,519,000	27.2	6,354,000	1,618,000	25.5
Louisiana	15,620,000	794,000	54,021,000	$1,277,000	2.4	6,774,000	21,199,000	(1)	[1] 43,307,000	71,280,000	7,919,000	11.1	140,921,000	9,990,000	7.1
Maryland									[2] 390,000	[2] 390,000	[2] 272,000	[2] 69.7	[2] 390,000	[2] 272,000	[2] 69.7
Michigan	1,329,000	134,000							1,264,000	1,264,000	445,000	35.2	2,593,000	579,000	22.3
Minnesota							1,106,000		5,183,000	6,289,000	1,383,000	22.0	6,289,000	1,383,000	22.0
Mississippi	38,000	4,000					837,000		4,682,000	5,519,000	724,000	13.1	5,557,000	728,000	13.1
Missouri	19,000	2,000				2,000	2,613,000	(1)	[1] 17,430,000	20,045,000	3,677,000	18.3	20,064,000	3,679,000	18.3
Montana	1,432,000	96,000				71,000	604,000		7,161,000	7,836,000	1,210,000	15.4	9,268,000	1,306,000	14.1
Nebraska							2,386,000	(1)	[1] 7,009,000	9,395,000	1,626,000	17.3	9,395,000	1,626,000	17.3
New Mexico	12,234,000	355,000				72,000	2,437,000		2,015,000	4,524,000	627,000	13.9	16,758,000	982,000	5.9
New York	122,000	27,000				2,126,000	1,470,000		15,836,000	19,432,000	3,865,000	19.9	19,554,000	3,892,000	19.9
North Dakota							(3)		(3)	(3)	(3)	(3)	(3)	(3)	(3)
Ohio	2,538,000	439,000				1,000	1,874,000		35,776,000	37,651,000	12,495,000	33.2	40,189,000	12,934,000	32.2
Oklahoma	192,658,000	5,909,000	(4)	(4)		9,453,000	7,345,000	(1)	[1][4] 24,006,000	[4] 40,804,000	[4] 3,857,000	[4] 9.5	233,462,000	9,766,000	4.2
Pennsylvania	4,602,000	1,295,000				1,411,000	132,000		45,400,000	46,943,000	12,778,000	27.2	51,545,000	14,073,000	27.3
South Dakota							712,000	(1)	[1] 2,078,000	2,790,000	472,000	16.9	2,790,000	472,000	16.9

See footnotes at end of table.

Industrial consumption of natural gas in the United States in 1935, by States and uses—Continued

State	Field (drilling, pumping, and operating gasoline recovery plants)		Manufacture of carbon black			Fuel at petroleum refineries, electric public-utility power plants, portland cement plants, and other industrial							Total industrial		
	M cubic feet (estimated)	Value at points of consumption (estimated)	M cubic feet	Value at points of consumption		M cubic feet					Value at points of consumption		M cubic feet	Value at points of consumption	
				Total	Average (cents)	Petroleum refineries	Electric public-utility power plants	Portland cement plants	Other industrial	Total	Total	Average (cents)		Total	Average (cents)
Tennessee							3,651,000		2,475,000	6,126,000	$1,116,000	18.2	6,126,000	$1,116,000	18.2
Texas	199,876,000	$6,134,000	180,470,000	$2,368,000	1.3	25,515,000	31,288,000	5,259,000	44,373,000	106,435,000	15,132,000	14.2	486,781,000	23,634,000	4.9
Utah	81,000	3,000				7,000	[3] 226,000		[3] 6,719,000	[3] 6,952,000	[3] 749,000	[3] 10.8	[3] 7,033,000	[3] 752,000	[3] 10.7
Virginia									(2)	(2)	(2)	(2)	(2)	(2)	(2)
West Virginia	10,409,000	2,125,000				599,000	79,000		21,960,000	22,638,000	5,331,000	23.6	33,047,000	7,456,000	22.6
Wyoming	5,141,000	164,000	(4)	(4)		4,888,000	384,000		[4] 4,956,000	[4] 10,228,000	[4] 669,000	[4] 6.5	15,369,000	833,000	5.4
Miscellaneous			7,098,000	142,000	2.0			17,192,000							
Total, 1935	580,414,000	27,225,000	241,589,000	3,787,000	1.6	80,175,000	125,239,000	26,752,000	442,047,000	674,213,000	113,736,000	16.9	1,496,216,000	144,748,000	9.7
1934	554,542,000	28,356,000	229,933,000	4,016,000	1.7	79,965,000	127,896,000	27,331,000	365,824,000	601,016,000	101,569,000	16.9	1,385,491,000	133,941,000	9.7

[1] Gas used at portland-cement plants included under "Miscellaneous" for United States total and under "Other industrial" for State total to avoid disclosing figures of individual operators.
[2] Maryland includes District of Columbia and Virginia.
[3] Utah includes North Dakota.
[4] Gas used in manufacture of carbon black included under "Miscellaneous" for United States total and under "Other industrial" for State total to avoid disclosing figures of individual operators.

Mixed gas.—Information on the blending of natural gas with manufactured gas in the production of mixed gas is not available for 1936, but there is little doubt that expansion in this branch of the industry was proportionate with the rise in total distribution. In fact, in 1935 the use of natural gas to enrich manufactured gas was increasing faster than total consumption. In 1935, 54,000,000,000 cubic feet of natural gas were mixed with manufactured gas, compared with 48,970,000,000 cubic feet in 1934. The average value of this natural gas at points of consumption (assumed to be the same as the average value of the mixed gas) was 92.1 cents per thousand cubic feet, compared with a national average of 22.4 cents per thousand and with a weighted average of 46.5 cents for the States distributing mixed gas.

Consumption of natural gas used with manufactured gas in the United States in 1935, by States

State	Domestic		Commercial		Industrial (M cubic feet)	Total	
	Consumers	M cubic feet	Consumers	M cubic feet		M cubic feet	Value at points of consumption
District of Columbia	130, 250	2, 111, 000	6, 590	274, 000	322, 000	2, 707, 000	$2, 126, 000
Illinois	977, 390	14, 381, 000	57, 930	3, 072, 000	4, 662, 000	22, 115, 000	23, 604, 000
Indiana	128, 620	656, 000	7, 110	140, 000	183, 000	979, 000	1, 074, 000
Iowa	49, 840	1, 260, 000	3, 170	203, 000	66, 000	1, 529, 000	1, 731, 000
Kentucky	67, 930	2, 573, 000	7, 140	693, 000	737, 000	4, 003, 000	2, 099, 000
Maryland	12, 130	192, 000	270	5, 000	8, 000	205, 000	197, 000
Michigan	----------	----------	----------	----------	404, 000	404, 000	175, 000
Minnesota	111, 730	2, 330, 000	5, 120	196, 000	357, 000	2, 883, 000	3, 131, 000
Missouri	213, 940	2, 317, 000	8, 300	305, 000	286, 000	2, 908, 000	3, 107, 000
Nebraska	52, 490	940, 000	320	54, 000	95, 000	1, 089, 000	730, 000
New York	265, 220	8, 510, 000	22, 980	1, 126, 000	964, 000	10, 600, 000	8, 477, 000
Ohio	151, 150	2, 051, 000	14, 720	672, 000	418, 000	3, 141, 000	2, 123, 000
Pennsylvania	47, 950	1, 111, 000	4, 150	243, 000	83, 000	1, 437, 000	1, 141, 000
Total, 1935	2, 208, 640	38, 432, 000	137, 800	6, 983, 000	8, 585, 000	54, 000, 000	49, 715, 000
1934	2, 012, 530	35, 587, 000	134, 220	6, 345, 000	7, 038, 000	48, 970, 000	45, 446, 000

INTERSTATE MOVEMENTS

Data on interstate movements of natural gas in 1936 are not available, but the final figure for 1935 (469,024,000,000 cubic feet) was 13 percent higher than that for 1934. For many years the trend has been toward interstate shipment of increasing proportions of the total gas requirements of the country as a corollary to the growth of long-distance gas transmission. The total gas shipped interstate in 1935, for example, was equivalent to 24.6 percent of the total consumption, compared with 23.5 percent in 1934.

Texas and Louisiana were the source of 54 percent of all gas entering interstate commerce in 1935, followed by West Virginia, which contributed 15 percent. Fourteen other States exported smaller amounts of gas. Interstate shipments increased from all States except Illinois, where they declined slightly, and Ohio, where the total movement to other States declined 21 percent from 1934. Interstate movements increased most in 1935 over 1934 between Texas and Illinois and West Virginia and Ohio. The largest single movement in 1935 was that from West Virginia to Ohio.

There is reason to believe that the interstate volume has continued to expand through 1936 and early 1937, with perhaps some acceleration.

Interstate transportation of natural gas in 1935 [1]

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Colorado	Wyoming	Utah	2,344,000
		Wyoming	174,000
			2,518,000
Illinois		Indiana	3,000
Indiana		Illinois	34,000
		Kentucky	154,000
			188,000
Kansas		Colorado	338,000
	Missouri	Illinois	2,107,000
	do. Illinois	Indiana	855,000
	Nebraska	Iowa	6,980,000
	do. Iowa	Minnesota	6,025,000
		Missouri	3,799,000
		Nebraska	7,724,000
	Nebraska Iowa	do.	3,000
		Oklahoma	621,000
	Nebraska Iowa	South Dakota	886,000
			29,338,000
Kentucky	West Virginia Virginia Maryland	District of Columbia	2,707,000
	Indiana	Illinois	110,000
		Indiana	557,000
	West Virginia Virginia Maryland District of Columbia	Maryaind	205,000
		Ohio	1,301,000
	West Virginia	do.	7,002,000
	do.	Pennsylvania	11,063,000
	do. Virginia Maryland	do.	23,000
	West Virginia	Virginia	274,000
	do. Virginia Maryland District of Columbia	do.	69,000
		West Virginia	6,586,000
			29,897,000
Louisiana	Mississippi	Alabama	9,996,000
		Arkansas	19,785,000
	Mississippi Alabama	Georgia	8,004,000
	Arkansas Missouri	Illinois	13,574,000
		Mississippi	2,051,000
	Arkansas	do.	1,379,000
	do.	Missouri	10,517,000
	do. Mississippi	Tennessee	9,479,000
		Texas	27,013,000
			101,798,000
Mississippi		Alabama	567,000
	Alabama	Florida	692,000
	do.	Georgia	78,000
		Louisiana	2,971,000
			4,308,000
Missouri		Illinois	163,000
	Illinois	Indiana	68,000
			231,000
Montana		North Dakota	1,382,000
		South Dakota	3,094,000
			4,476,000

[1] Includes exports to Canada and Mexico.

Interstate transportation of natural gas in 1935—Continued

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
New Mexico	Texas New Mexico	Arizona	5,603,000
		Colorado	137,000
		Texas	4,811,000
			10,551,000
New York		Canada	29,000
	New Jersey	New York	80,000
		Pennsylvania	1,085,000
			1,194,000
Ohio		Indiana	643,000
		Kentucky	4,000
		Pennsylvania	8,000
		West Virginia	188,000
			843,000
Oklahoma		Arkansas	524,000
	Kansas Nebraska	Iowa	1,000
		Kansas	16,726,000
	Kansas Nebraska Iowa	Minnesota	2,000
	Kansas	Missouri	6,342,000
	do	Nebraska	455,000
		Texas	1,230,000
			25,280,000
Pennsylvania	New York	Canada	44,000
		New York	28,531,000
		Ohio	495,000
	West Virginia	do	465,000
		West Virginia	1,023,000
			30,558,000
Texas	New Mexico	Colorado	16,433,000
	Oklahoma Kansas Nebraska Iowa	Illinois	36,543,000
	Oklahoma Kansas Missouri	do	3,343,000
	Oklahoma Kansas Nebraska Iowa Illinois	Indiana	10,544,000
	Oklahoma Kansas Missouri Illinois	do	1,354,000
	Oklahoma Kansas Nebraska	Iowa	12,096,000
	Oklahoma	Kansas	28,293,000
		Louisiana	1,311,000
		Mexico	6,727,000
	Oklahoma Kansas Nebraska Iowa	Minnesota	4,552,000
	Oklahoma Kansas	Missouri	12,024,000
	Oklahoma Kansas Nebraska Iowa	Nebraska	5,450,000
	Oklahoma Kansas	do	3,000
		New Mexico	1,039,000
		Oklahoma	8,944,000
	Oklahoma Kansas Nebraska Iowa	South Dakota	668,000
	New Mexico Colorado	Wyoming	399,000
			149,723,000

Interstate transportation of natural gas in 1935—Continued

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
West Virginia		Kentucky	5,827,000
		Maryland	579,000
		Ohio	41,944,000
	Kentucky	do	5,940,000
		Pennsylvania	15,493,000
	Virginia and Maryland	do	23,000
			69,806,000
Wyoming		Montana	1,332,000
		Nebraska	675,000
		Utah	6,305,000
			8,312,000
			469,024,000

Pipe-line developments.—Most of the important natural-gas pipe lines constructed in 1936 were built east of the Mississippi River. The large Detroit gas market was supplied with natural gas by completion of a connecting link to the Panhandle Eastern line; this comprised 235 miles of 22-inch pipe from a point near Zionsville, Ind., to Detroit, laid at a cost of $5,400,000. The gas is brought from the Texas Panhandle and Southwestern Kansas fields. Other construction work in Michigan included 46 miles of 10-inch pipe to Grand Rapids from the Six Lakes field in the central part of the State and 62 miles of 20-inch line from the same field to Lansing.

About 140 miles of 10- and 8-inch pipe line were built to bring Oriskany-sand gas from the fields of Potter County, Pa., to Batavia and Dunkirk, N. Y. In January 1937 deliveries commenced through a new 14-inch line from the same area to Rochester to supply the Eastman Kodak plant and other consumers near the line. A 12¾-inch line was built from Hebron Township, Potter County, Pa., southwestward 113 miles to Pew Station, near New Bethlehem, Clarion County, Pa., where it connects with two trunk lines running into the Pittsburgh district. One major gas line was laid in West Virginia during the year; it runs from Clendenin, Kanawha County, northward to Hastings, Wetzel County, where it connects with lines into Pennsylvania and Ohio and comprises about 100 miles of 12¾-inch pipe. Most of the new construction in the Appalachian fields in 1936 was based largely upon the recent development of substantial gas reserves in several Oriskany-sand areas at depths of 4,000 to 5,000 feet.

In the midcontinent and southwestern part of the country there were numerous small gas pipe-line projects but very few large ones. In Kansas a 20-inch line was laid from the Hugoton field eastward, a distance of 107 miles, to connect at Mullinville with a 26-inch trunk line taking gas from the Texas Panhandle to Nebraska and other northern areas. From the Otis field, Rush County, Kans., 125 miles of 6- and 8-inch lines were laid to Holdredge, Nebr. A line to supply gas to industrial consumers was being completed at the end of 1936 in the Texas gulf coast; it runs from the Tomball field, Harris County, 120 miles to Houston, Baytown, Port Arthur, Beaumont, and Port Neches. The line is of 10-inch pipe and has a rated capacity of 60,000,000 cubic feet per day.

NATURAL GASOLINE [1]

By G. R. Hopkins

SUMMARY OUTLINE

For the natural-gasoline industry the year 1936, like 1935, was one of general tranquillity and progress. Production increased 7 percent over 1935, and demand was 5 percent higher. Stocks increased but

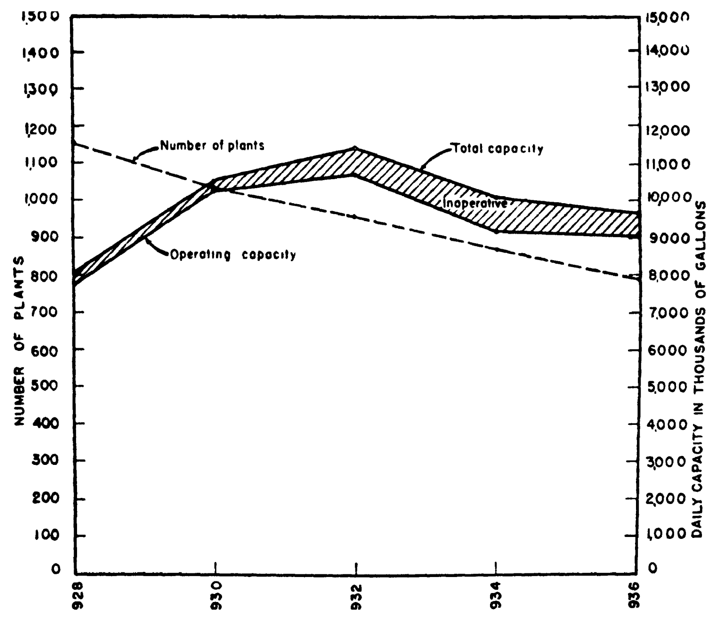


FIGURE 76.—Number and capacity of natural-gasoline plants on January 1, 1928, 1930, 1932, 1934, and 1936.

not enough to cause pronounced weakening in the market. A decline in exports was nearly balanced by a gain in "direct" shipments, although refinery demand continued to account for more than 80 percent of the total.

The average plant value of natural gasoline for 1936 is estimated at 4.6 cents per gallon, an increase of 0.3 cent over 1935. Although this gain undoubtedly permitted some of the less-profitable plants to keep going, it is doubtful if it was enough to prevent a further decline in the total number operating. (See fig. 76.)

[1] Data for 1936 are preliminary; detailed statistics with final revisions will be released later.

Salient statistics of the natural-gasoline industry, 1926 and 1934-36

[Thousands of gallons]

	1926	1934	1935	1936 [1]	Percent of change in 1936 from 1935
Production	1,363,090	1,585,360	1,651,986	1,765,722	+6.9
Stocks:					
Total at plants, terminals, and refineries, Jan. 1	(2)	154,560	177,086	155,316	
Total at plants, terminals, and refineries, Dec. 31	(2)	157,060 [3] 177,086	155,316	170,310	+9.7
Net change	(2)	+2,500	−21,770	+14,994	
Total supply [4]	(2)	1,532,860	1,673,756	1,750,728	+4.6
Distribution:					
Blended at refineries [5]	1,024,758	1,132,152	1,271,760	1,367,814	+7.6
Run through crude-oil pipe lines in California	138,474	50,652	31,290	52,500	+67.8
Exports	(2)	214,242	135,366	107,058	−20.9
Sales to jobbers and retailers	(2)		116,340	139,230	+19.7
Losses	(2)	135,814	119,000	84,126	−29.3
Total distribution	(2)	1,532,860	1,673,756	1,750,728	+4.6

[1] Preliminary.
[2] Not available.
[3] For comparison with 1935.
[4] Production plus or minus changes in stocks.
[5] Including amounts run through crude-oil pipe lines east of California.

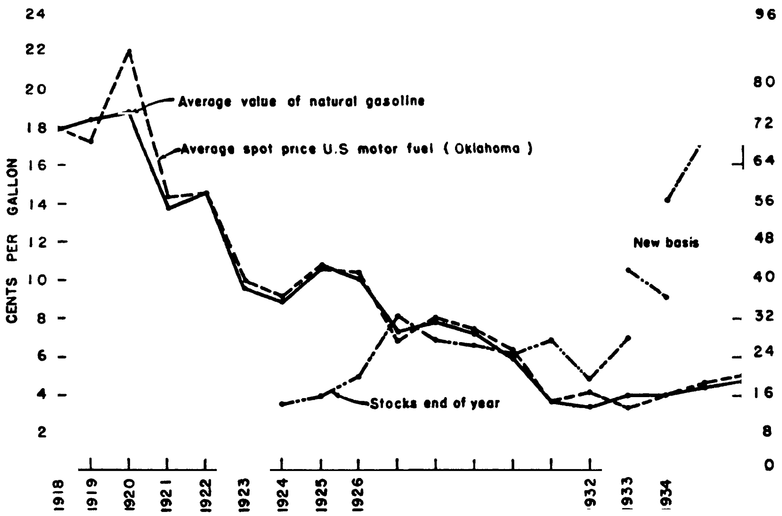


FIGURE 77.—Trends in average value of natural gasoline, spot price of gasoline, and stocks of natural gasoline, 1918-36.

PRICES AND MARKET CONDITIONS

Prices of natural gasoline in 1936 were probably satisfactory to most producers; at least fewer charges of dumping and distress sales were made than for several years.

The average value of natural gasoline at the plants in 1935 was 4.3 cents per gallon compared with 3.9 cents in 1934. The final figure for 1936 is not available, but the trend of spot prices indicates that the plant value was about 4.6 cents per gallon.

The records of spot prices of a representative grade of natural gasoline for recent years indicate an increasing tendency for quotations to resist the spring slump. In other words, prices in the last 2 years have not fluctuated as much as those in prior years. (See fig. 77.)

Spot price of Oklahoma natural gasoline, grade 26–70, on specified dates in 1936, with monthly and yearly averages, in cents per gallon

[National Petroleum News]

Date	Cents	Date	Cents	Date	Cents
Jan. 1	3.63-3.75	May 4	2.75	Sept. 8	4.25
Jan. 6	3.38-3.50	May 11	2.75	Sept. 14	4.25
Jan. 13	3.38-3.50	May 18	2.75	Sept. 21	4.50
Jan. 20	3.88	May 25	2.75	Sept. 28	4.50
Jan. 27	4.00	Average	2.75	Average	4.38
Average	3.69	June 1	2.75	Oct. 5	4.50
Feb. 3	4.00	June 8	2.63	Oct. 12	4.50
Feb. 10	4.00	June 15	2.50	Oct. 19	4.50
Feb. 17	4.00	June 22	2.38-2.50	Oct. 26	4.50
Feb. 24	3.25-3.50	June 29	2.50	Average	4.50
Average	3.84	Average	2.56	Nov. 2	4.50
Mar. 2	3.00	July 6	2.75	Nov. 9	4.50
Mar. 9	3.00-3.13	July 13	2.75	Nov. 16	4.50
Mar. 16	3.00	July 20	2.75	Nov 23	4.75
Mar. 23	3.00	July 27	3.25	Nov 30	4.75
Mar. 30	3.00	Average	2.88	Average	4.60
Average	3.01	Aug. 3	3.75	Dec. 7	4.75
Apr. 6	3.00	Aug. 10	3.75	Dec. 14	4.75
Apr. 13	3.00	Aug. 17	4.00	Dec. 21	4.25
Apr. 20	3.00	Aug. 24	4.00	Dec. 28	3.75-4.00
Apr. 27	2.88-3.00	Aug. 31	4.25	Average	4.41
Average	2.98	Average	3.95		
				Average, 1936	3.63
				1935	3.34

EMPLOYMENT AND EXPENDITURES

Under a cooperative arrangement with the Bureau of the Census, the Bureau of Mines collected data on employment, wages, salaries, and expenditures for the natural-gasoline industry in 1935. This census of the industry was the first ever made which did not include petroleum production. The results were published in a release of the Census of Business dated March 3, 1937, and the State totals are summarized in the following table.

In 1935 the average number of wage earners employed at natural-gasoline plants was 7,997; salaried employees, including salaried officers, supervisory and technical employees, and the clerical force at the plants, totaled 1,052 about the middle of December. In addition, there were a thousand or more salaried employees at central administrative offices devoting at least half their time to natural-gasoline operations.

Wages totaled $10,567,000 and plant salaries $2,105,000. The "average wage" was, accordingly, about $25 per week and the "average annual salary" about $2,000. Wages and salaries at the plants were 18 percent of the plant value and total expenditures for supplies and materials, fuel, and electricity were also 18 percent.

The principal expense, the cost of the gas, was not included in the expenditures reported.

Employment and expenditures at natural-gasoline plants in 1935, by States

State	Wage earners		Salaried employees		Expenditures (thousands of dollars)			
	Number [1]	Wages (thousands of dollars)	Number [2]	Salaries (thousands of dollars)	Supplies and materials [3]	Fuel	Purchased electric current	Blending materials
Arkansas	106	135	28	55	204	88	11	286
California	1,498	2,402	207	559	2,083	785	149	5
Colorado	10	15	2	4	3	1		
Illinois	58	52	4	7	62	16	2	
Kansas	182	199	40	63	190	42	10	10
Kentucky	52	55	9	15	36	25	5	
Louisiana	225	317	45	91	268	110	21	8
Michigan	14	24	3	4	36	10	2	
Montana	8	12	1	3	9	7	1	
New Mexico	88	121	5	7	53	10	2	
Ohio	101	94	13	13	88	40	6	
Oklahoma	2,485	3,182	191	361	1,757	609	118	40
Texas	2,205	2,833	406	763	3,137	577	125	204
West Virginia	534	592	56	101	363	141	14	
Wyoming	230	350	30	49	394	50		2
New York and Pennsylvania	201	184	12	10	202	109	15	30
United States	7,997	10,567	1,052	2,105	8,885	2,620	481	585

[1] Number of wage earners determined by averaging the total number reported on pay rolls the 15th of each month.
[2] Includes salaried officers, supervisory and technical employees, and clerks and others receiving compensation on a salary basis.
[3] Includes cost of repair parts, machinery supplies, additional units, new gathering lines, and all other equipment necessary to maintain and operate the plant, but excludes costs of new plants.

PRODUCTION

Trends in total output.—As shown in figure 78, there is a close relationship between crude-oil production and natural-gasoline production. Both declined sharply during the depression. Since then they have recovered materially, particularly crude-oil production, which reached a new record in 1936.

As 1936 opened, the daily average production of natural gasoline was about 5,000,000 gallons, but declines in the spring months brought the average down to about 4,500,000 gallons by the middle of the year. Substantial gains in output in the Panhandle, Kettleman Hills, and Rodessa fields in the fall and early winter raised the average to about 5,400,000 gallons in December.

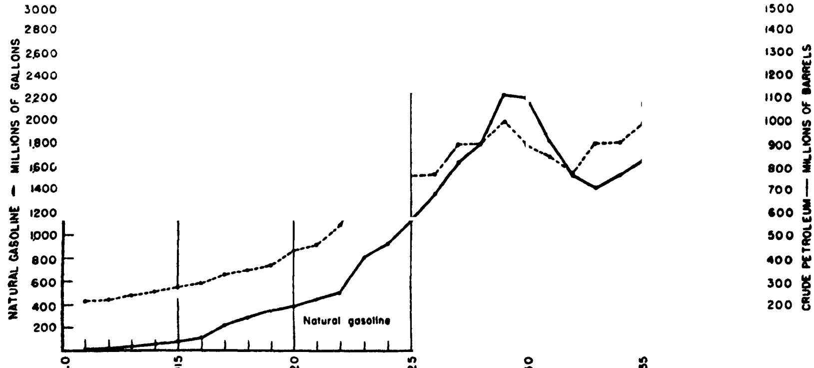


FIGURE 78.—Annual production of natural gasoline and crude petroleum, 1911-36.

Monthly production of natural gasoline in the United States in 1935, by fields, in millions of gallons

Field	January	February	March	April	May	June	July	August	September	October	November	December	Total
Appalachian	6.6	5.9	5.7	5.4	4.8	3.8	3.5	3.7	4.1	5.4	5.7	6.7	61.3
Kentucky, Illinois, and Michigan	.9	.8	.9	.8	.8	.7	.7	.7	.9	.9	1.0	1.0	10.1
Oklahoma:													
Oklahoma City	9.5	8.3	9.1	9.3	9.2	8.8	9.5	9.3	9.7	12.1	13.4	11.9	120.1
Osage County	3.7	3.5	3.9	4.1	3.9	3.7	3.9	4.2	3.9	4.4	4.4	4.0	47.6
Seminole	7.3	7.1	7.7	7.9	8.3	8.3	8.5	8.2	8.4	9.2	8.4	8.3	97.6
Rest of State	9.3	8.7	9.4	9.4	9.8	9.2	9.2	9.1	9.2	10.5	10.4	10.4	114.6
Total, Oklahoma	29.8	27.6	30.1	30.7	31.2	30.0	31.1	30.8	31.2	36.2	36.6	34.6	379.9
Kansas	2.7	2.8	2.7	2.8	2.5	2.4	2.3	2.3	2.5	3.0	3.3	3.2	32.5
Texas:													
Gulf	3.2	3.1	2.8	2.6	2.8	2.7	2.8	2.7	2.6	2.5	2.4	2.6	32.8
East Texas	4.9	4.7	5.1	5.1	6.1	6.8	7.5	7.9	7.6	7.7	7.3	7.5	78.2
North Texas	2.0	1.9	2.2	2.0	2.0	1.8	1.9	1.8	1.8	2.0	2.0	2.0	23.4
Panhandle	25.9	22.5	24.2	23.6	24.5	22.7	23.5	16.8	19.9	23.7	24.6	24.7	276.6
West-central	6.5	5.8	6.6	6.1	6.5	6.3	6.3	6.3	6.2	6.7	6.6	6.8	76.7
Rest of State	2.3	2.2	2.4	2.4	2.4	2.5	2.6	2.8	2.6	2.5	2.3	2.1	29.1
Total, Texas	44.8	40.2	43.3	41.8	44.3	42.8	44.6	38.3	40.7	45.1	45.2	45.7	516.8
Louisiana	4.0	3.9	3.6	3.6	3.9	3.7	3.9	4.1	4.2	4.4	5.0	5.4	49.7
Arkansas	1.0	1.0	1.2	1.1	1.1	1.1	1.2	1.2	1.1	1.1	1.0	1.0	13.1
Rocky Mountain	4.8	4.1	4.4	4.2	4.2	4.2	4.4	4.3	4.5	4.9	4.8	5.2	54.0
California:													
Huntington Beach	3.2	2.9	3.3	3.2	3.1	3.5	3.7	3.9	3.9	4.2	4.1	4.3	43.3
Kettleman Hills	15.8	12.3	14.7	11.4	9.1	8.6	9.5	11.6	13.7	15.9	15.6	15.7	153.9
Long Beach	6.2	5.8	6.6	6.4	6.7	6.8	7.3	7.5	7.1	7.7	7.6	8.0	83.7
Santa Fe Springs	5.0	4.6	5.2	4.9	4.7	4.6	4.8	5.2	5.7	5.9	5.5	5.6	61.7
Ventura Avenue	4.1	3.8	3.9	3.2	3.6	3.7	3.4	3.8	3.9	4.2	4.5	4.7	46.8
Rest of State	10.7	9.7	11.4	10.5	11.1	12.3	13.1	13.0	12.7	13.1	13.2	14.4	145.2
Total, California	45.0	39.1	45.1	39.6	38.3	39.5	41.8	45.0	47.0	51.0	50.5	52.7	534.6
Total, United States	139.6	125.4	137.0	130.0	131.1	128.2	133.5	130.4	136.2	152.0	153.1	155.5	1,652.0
Daily average	4.5	4.5	4.4	4.3	4.2	4.3	4.3	4.2	4.5	4.9	5.1	5.0	4.5

Monthly production of natural gasoline in the United States in 1936, by fields, in millions of gallons [1]

Field	January	February	March	April	May	June	July	August	September	October	November	December	Total
Appalachian	6.8	6.7	6.3	6.1	4.8	4.2	3.9	4.1	4.6	6.0	6.8	7.3	67.6
Kentucky, Illinois, and Michigan	1.0	.9	.9	.9	.8	.7	.8	.7	.8	1.1	1.1	1.1	10.8
Oklahoma:													
Oklahoma City	12.9	11.1	11.2	10.0	9.4	8.9	9.9	10.9	10.8	12.3	12.5	13.7	133.6
Osage County	3.9	3.3	4.2	4.0	4.1	4.2	4.3	4.5	4.6	4.7	4.4	4.3	50.5
Seminole	8.2	7.2	9.1	9.6	10.0	9.7	9.6	9.9	9.7	10.0	9.7	10.4	113.1
Rest of State	9.9	8.6	10.1	10.0	9.8	9.5	9.7	10.0	10.1	11.2	11.1	11.5	121.5
Total, Oklahoma	34.9	30.2	34.6	33.6	33.3	32.3	33.5	35.3	35.2	38.2	37.7	39.9	418.7
Kansas	3.1	2.7	2.8	2.8	2.7	2.6	2.6	2.8	3.1	3.7	4.0	4.0	36.9
Texas:													
Gulf	1.7	1.5	1.4	1.7	1.8	1.9	2.2	2.2	2.1	2.2	2.0	1.9	22.6
East Texas	8.0	7.9	10.5	11.0	11.8	12.2	13.0	13.0	13.7	12.4	10.9	11.2	135.6
North Texas	2.0	1.8	2.1	2.0	1.8	1.7	1.8	1.8	1.8	2.0	2.1	2.2	23.1
Panhandle	23.8	17.6	17.3	15.0	15.0	14.6	15.0	15.5	17.3	18.7	18.4	20.1	208.3
West-central	6.4	6.0	6.5	6.0	6.2	5.8	6.1	6.1	6.1	6.2	5.9	6.0	73.3
Rest of State	2.5	2.5	2.6	2.5	2.5	2.6	2.8	3.8	3.4	3.8	3.9	4.3	37.2
Total, Texas	44.4	37.3	40.4	38.2	39.1	38.8	40.9	42.4	44.4	45.3	43.2	45.7	500.1
Louisiana	5.2	5.2	4.1	4.6	4.2	4.0	4.3	4.7	5.3	6.7	9.3	9.9	67.5
Arkansas	.9	.8	1.1	1.1	1.1	1.0	1.0	1.0	1.0	1.0	.9	.9	11.8
Rocky Mountain	5.0	4.4	5.1	4.6	4.8	5.4	5.5	5.6	5.7	6.1	6.1	6.2	64.5
California:													
Huntington Beach	4.0	3.6	3.7	3.5	3.7	3.5	3.5	3.6	3.5	3.6	3.3	3.3	42.8
Kettleman Hills	15.3	14.3	13.2	13.0	12.3	12.2	13.0	14.8	15.5	16.2	15.8	16.0	171.6
Long Beach	7.8	7.1	7.5	7.1	7.4	7.4	7.6	7.7	7.4	7.5	7.2	7.2	88.9
Santa Fe Springs	5.2	4.3	4.5	4.3	4.8	4.5	4.9	4.9	4.7	4.8	4.6	4.7	56.2
Ventura Avenue	4.6	4.0	4.2	3.5	3.6	3.6	4.1	4.1	4.1	4.5	4.8	4.8	49.9
Rest of State	15.2	12.7	13.5	13.8	15.0	14.9	15.3	15.6	15.2	16.2	15.5	15.5	178.4
Total, California	52.1	46.0	46.6	45.2	46.8	46.1	48.4	50.7	50.4	52.8	51.2	51.5	587.8
Total, United States	153.4	134.2	141.9	137.1	137.6	135.1	140.9	147.3	150.5	160.9	160.3	166.5	1,765.7
Daily average	4.9	4.6	4.6	4.6	4.4	4.5	4.5	4.8	5.0	5.2	5.3	5.4	4.8

[1] Preliminary.

California.—Production in California in 1936 totaled 587,829,000 gallons, or 10 percent above the 1935 output. Although this marked the third successive yearly gain in production in the State, the 1936 total was far under the peak (840,325,000 gallons) of 1929. Despite a slump in output in the spring months following reductions in crude-oil production, Kettleman Hills established a new record output of 171,600,000 gallons, or nearly 18,000,000 gallons above the 1935 total. The rest of the increase in production in the State in 1936 over 1935 was registered in the smaller fields; the old substantial producers, Long Beach, Santa Fe Springs, Ventura Avenue, and Huntington Beach, showed little change.

Natural gasoline produced in the United States, 1911–36, by States, in thousands of gallons

Year	Alaska	Arkansas	California	Colorado	Illinois	Indiana	Kansas	Kentucky	Louisiana	Michigan	Montana	New Mexico
1911			(1)	(1)	(1)			(1)				
1912			1,041	(1)	(1)			(1)				
1913			3,461	(1)	(1)		(1)	(1)				
1914			7,581	(1)	1,164		(1)	(1)				
1915			12,835	(1)	1,035		(1)	(1)	(1)			
1916			17,159	(1)	2,260		215	725	2,113			
1917			28,818	(1)	4,934		1,175	3,818	4,980			
1918			32,269	2	4,575		2,390	3,331	7,021			
1919			40,386		6,060		3,284	5,136	10,063			
1920			48,208		6,055		4,331	4,497	10,610			
1921			58,220		7,536		3,587	4,242	15,341			
1922		4,289	67,120		7,760		2,856	5,205	29,406			
1923		16,183	173,329		7,356		8,775	7,601	40,720			
1924		17,533	232,579		9,091		11,658	7,274	48,098			
1925	33	19,686	303,180	35	9,874		19,592	7,685	43,489			
1926	33	30,385	389,366	276	9,987		25,369	7,689	43,557			1,488
1927	19	37,498	498,020	912	8,853		36,095	7,480	44,844			1,827
1928	26	32,677	584,111	1,909	7,817		36,765	7,267	55,022			1,506
1929	35	33,455	840,325	1,630	7,080	2	36,227	6,006	64,957			1,077
1930	39	30,637	829,713	1,322	6,867	2	35,106	6,641	73,693			3,663
1931	32	26,282	680,339	659	5,024	1	32,690	5,464	58,034			17,775
1932	25	18,653	551,897	472	4,558	1	24,792	4,877	46,199			17,507
1933	25	15,215	496,293	408	3,673		24,869	4,514	36,973	188	1,295	19,149
1934		13,033	506,272	643	3,810		27,891	4,171	40,558	589	1,237	21,748
1935		13,076	534,624	417	2,642		32,507	5,614	49,732	1,850	1,739	19,563
1936 [2]		11,832	587,829	186	2,258		36,908	6,552	67,503	2,014	2,061	28,369

Year	New York	Ohio	Oklahoma	Pennsylvania	Texas	West Virginia	Wyoming	Miscellaneous	Total	Value at plant: Thousands of dollars	Value at plant: Average per gallon (cents)
1911	(1)	1,679	388	1,467		3,660		232	7,426	532	7.2
1912	(1)	1,719	1,575	2,041		5,318		387	12,081	1,157	9.6
1913	(1)	2,073	6,463	3,680		7,662		722	24,061	2,458	10.2
1914	(1)	2,440	17,278	4,612		9,278		300	42,653	3,106	7.3
1915	(1)	2,199	31,666	5,899	(1)	10,854		877	65,365	5,151	7.9
1916	(1)	2,639	48,360	9,715	1,293	18,765		249	103,493	14,331	13.8
1917	(1)	5,440	115,123	13,826	6,920	32,669		181	217,884	40,189	18.4
1918	218	6,745	163,701	15,775	7,326	37,604	1,579		282,536	50,364	17.8
1919	458	8,801	189,995	20,284	9,337	52,150	5,581		351,535	64,197	18.3
1920	411	10,016	178,857	21,151	32,956	58,941	8,711		384,744	71,788	18.7
1921	366	9,100	185,341	19,856	77,141	54,646	14,558		449,934	61,815	13.7
1922	506	8,600	189,404	18,518	95,405	56,796	19,967		505,832	72,711	14.4
1923	408	10,035	270,249	19,132	177,765	63,381	21,292		816,226	77,268	9.5
1924	477	9,443	301,062	19,254	186,571	61,549	29,272		933,861	82,233	8.8
1925	414	8,701	390,861	18,850	214,092	58,201	32,777		1,127,470	120,383	10.7
1926	539	10,817	475,716	20,343	243,093	63,807	40,625		1,363,090	136,412	10.0
1927	449	12,167	548,109	16,744	320,723	64,192	43,212		1,641,144	118,688	7.2
1928	392	13,174	619,691	16,571	324,516	69,729	42,861		1,814,034	138,944	7.7
1929	264	11,166	676,030	18,411	419,485	72,994	44,544		2,233,688	158,410	7.1
1930	208	8,937	591,194	16,713	491,299	63,328	51,132		2,210,494	128,160	5.8
1931	132	5,199	454,886	14,339	426,695	52,844	51,523		1,831,918	63,732	3.5
1932	117	5,163	378,584	11,685	371,106	43,773	44,391		1,523,800	49,244	3.2
1933	96	4,662	360,488	11,686	366,515	39,848	34,103		1,420,000	54,368	3.8
1934	85	5,881	355,438	10,781	466,570	41,854	34,799		1,535,360	60,523	3.9
1935	27	6,232	379,913	12,623	516,748	42,433	32,246		1,651,986	70,940	4.3
1936 [2]	22	6,992	418,721	14,260	500,094	46,288	33,833		1,765,722	81,750	4.6

[1] Included under Miscellaneous. [2] Preliminary figures.

Texas.—Despite a material gain in crude-oil production the output of natural gasoline in Texas declined in 1936. This unusual occurrence resulted primarily from curtailed operations at the "stripper" plants utilizing "dry" gas in the Panhandle; in fact, the production from "wet" or casinghead gas increased materially.

Production in the Panhandle in 1936 was 208,326,000 gallons compared with 276,602,000 gallons in 1935. Most, or perhaps all, of the decrease was recorded at the "stripper" plants. Although at various times "stripping" has apparently been outlawed in Texas, most of the "stripper" producers have continued operations on a scale contingent upon injunctions and the ability to find markets for the residue gas.

Production in the east Texas field again recorded a material gain; the output increased to 135,573,000 gallons in 1936, or 73 percent more than in 1935. This gain reflected chiefly increased operations due to the construction of new units and the expansion of gas-collecting facilities at existing plants.

Natural gasoline produced and natural gas treated in the United States in 1935, by States

State	Number of operators [1]	Number of plants operating	Natural gasoline produced			Natural gas treated	
			Thousands of gallons	Value at plants		Millions of cubic feet	Average yield per M cubic feet (gallons)
				Thousands of dollars	Average per gallon (cents)		
Arkansas	6	8	13,076	570	4.4	3,371	3.88
California	34	91	534,624	29,778	5.6	310,016	1.72
Colorado	2	2	417	15	3.6	222	1.88
Illinois	21	65	2,642	141	5.3	1,076	2.46
Kansas	11	19	32,507	1,145	3.5	87,669	.37
Kentucky	5	5	5,614	287	5.1	29,772	.19
Louisiana	14	26	49,732	1,871	3.8	81,868	.61
Michigan	2	2	1,850	71	3.8	1,755	1.05
Montana	1	1	1,739	151	8.7	6,382	.27
New Mexico	2	2	19,563	699	3.6	11,786	1.66
New York	1	1	27	2	7.4	27	1.00
Ohio	6	11	6,232	358	5.7	29,622	.21
Oklahoma	64	162	379,913	14,593	3.8	260,757	1.46
Pennsylvania	61	107	12,623	628	5.0	33,348	.38
Texas	68	123	516,748	17,050	3.3	822,570	.62
West Virginia	28	81	42,433	2,070	4.9	118,789	.36
Wyoming	6	9	32,246	1,511	4.7	16,970	1.90
Total, 1935	[1] 278	715	1,651,986	70,940	4.3	1,822,000	.91
Total, 1934	[1] 288	766	1,535,360	60,523	3.9	1,776,172	.86

[1] A producer operating in more than 1 State is counted only once.

Oklahoma.—Oklahoma, like California, has increased its output of natural gasoline in recent years, but production is still far below that of 1929 and 1930. In 1936 the output was 418,721,000 gallons compared with 379,913,000 gallons in 1935 and 676,030,000 gallons in the peak year 1929. The gain in output in 1936 was distributed among the major producing districts, indicating that it was related to the increase in crude-oil production rather than to new discoveries or construction.

Louisiana.—Production in Louisiana in 1936 was 67,503,000 gallons, or 36 percent above the total in 1935. This gain, which brought production virtually to the record level of 1930, resulted primarily from the treating of gas from the Rodessa oil field.

Other States.—The output in West Virginia continued to recover from the depression slump in the demand for gas; the total for 1936 was 46,288,000 gallons compared with 42,433,000 gallons in 1935. Both Kansas and New Mexico showed substantial gains in production in 1936; the increase in Kansas was due chiefly to increased casinghead-gas production and that in New Mexico to new construction.

CONSUMPTION AND MOVEMENTS

The indicated domestic consumption of natural gasoline in 1936 was 1,750,728,000 gallons, of which 84,126,000 gallons were "losses." Of the remainder, 85 percent was utilized at refineries, 7 percent was exported, and 8 percent went into "direct" shipments to bulk plants, jobbers, and retailers. Compared with similar data for 1935, these ratios indicate a small gain in the relative importance of refinery and "direct" uses which offset a decline in exports.

Distribution of natural gasoline, 1935–36, by months, in thousands of gallons

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1935													
Production	139,608	125,370	137,004	130,032	131,082	128,226	133,518	130,368	136,206	152,040	153,090	155,442	1,651,986
Decrease in stocks						3,196	3,562	7,903	20,790	31,458	19,488	9,324	21,770
	139,608	125,370	137,004	130,032	131,082	131,422	137,080	138,271	156,996	183,498	172,578	164,766	1,673,756
Used at refineries [1]	100,212	88,788	83,118	80,178	81,060	90,174	92,232	104,832	120,666	152,292	142,590	135,618	1,271,760
Run through pipe lines in California	2,184	1,722	1,932	2,100	1,806	2,982	2,562	2,982	2,688	3,822	3,150	3,360	31,290
Exports [2]	4,158	8,946	13,860	7,434	10,290	13,776	19,866	9,324	14,826	9,408	12,978	10,500	135,366
Shipments to bulk plants, jobbers, and retailers	6,510	7,644	9,156	9,324	8,988	10,752	8,610	8,736	8,232	13,104	11,802	13,482	116,340
Increase in stocks	15,256	8,473	17,652	16,127	16,443								
Losses	11,288	9,797	11,286	14,869	12,495	13,738	13,810	12,397	10,584	4,872	2,058	1,806	119,000
	139,608	125,370	137,004	130,032	131,082	131,422	137,080	138,271	156,996	183,498	172,578	164,766	1,673,756
1936 [3]													
Production	153,426	134,232	141,876	137,130	137,550	135,114	140,910	147,294	150,528	160,860	160,272	166,530	1,765,722
Decrease in stocks								8,106	29,736	16,380	16,884	4,116	
	153,426	134,232	141,876	137,130	137,550	135,114	140,910	155,400	180,264	177,240	177,156	170,646	1,765,722
Used at refineries [1]	118,272	84,504	99,540	84,210	81,984	84,798	106,974	116,718	132,426	153,804	156,408	148,176	1,367,814
Run through pipe lines in California	3,150	9,408	2,898	3,360	2,394	4,116	3,822	4,200	7,896	3,654	3,528	4,074	52,500
Exports [2]	2,520	6,762	6,048	10,332	5,334	10,500	7,980	9,198	15,120	11,046	11,004	11,214	107,058
Shipments to bulk plants, jobbers, and retailers	12,222	10,206	9,996	10,164	11,592	11,424	12,558	9,954	10,248	14,448	12,768	13,650	139,230
Increase in all stocks	9,996	11,844	14,070	21,210	25,452	6,930	714						14,994
Losses	7,266	11,508	9,324	7,854	10,794	17,346	8,862	15,330	14,574	−5,712	−6,552	−6,468	84,126
	153,426	134,232	141,876	137,130	137,550	135,114	140,910	155,400	180,264	177,240	177,156	170,646	1,765,722

[1] Includes quantities run through pipe lines east of California. [2] As reported to the Bureau of Mines by manufacturers. [3] Preliminary.

Refinery utilization.—The percentage of natural gasoline blended in refinery gasoline in 1936 was 6.70 compared with 6.68 in 1935. Except in 1933, the ratio has remained remarkably near 6.70 percent for the past 5 years.

The most important change in blending operations in 1936 occurred at refineries in the Texas Gulf Coast district, where 170,352,000 gallons were utilized in 1936 compared with 110,838,000 gallons in 1935. The Indiana-Illinois-Kentucky district also made a material gain in natural-gasoline consumption. Although most of the other districts used more natural gasoline in 1936 than in 1935, the percentages of the total refinery gasoline so used were lower because the percentage gain in total output of gasoline exceeded the relative increase in blending.

Percentage of natural gasoline blended in refinery gasoline, 1932–36, by districts

Year	East coast	Appalachian	Indiana, Illinois, Kentucky	Oklahoma, Kansas, Missouri	Texas inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas and Louisiana inland	Rocky Mountain	California	Total
1932	0.9	2.2	3.0	9.4	11.5	4.8	5.3	9.6	12.4	14.5	6.71
1933	1.6	1.4	2.8	9.0	11.0	3.5	2.0	4.8	10.1	15.6	6.31
1934	1.9	2.3	4.8	10.5	12.2	2.9	1.6	6.0	9.0	16.2	6.75
1935	2.0	1.6	4.1	10.1	12.5	2.7	1.8	5.7	7.9	16.1	6.68
1936 [1]	1.6	1.6	4.4	9.7	11.5	3.9	1.8	5.4	7.8	15.5	6.70

[1] Preliminary.

Natural gasoline blended at refineries in the United States, 1935–36, by districts and months, in thousands of gallons

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
1935													
East coast	6,216	3,780	4,032	1,680	840	1,302	1,596	2,982	5,712	10,122	11,004	11,340	60,606
Appalachian	1,470	1,428	1,302	798	630	588	756	1,092	924	1,344	1,428	1,344	13,104
Indiana, Illinois, Kentucky, etc	11,382	10,626	10,584	10,080	9,828	8,778	9,072	8,022	10,836	16,926	15,750	15,498	137,382
Oklahoma, Kansas, and Missouri	23,436	21,126	17,346	18,060	16,968	17,514	19,656	23,100	24,822	29,862	29,232	26,754	267,876
Texas:													
Gulf coast	9,450	6,846	5,754	4,914	4,368	5,250	6,258	10,836	12,138	14,238	14,280	16,506	110,838
Inland	15,960	13,692	11,046	9,198	11,802	11,550	11,256	14,280	17,178	21,420	22,176	18,354	177,912
Total, Texas	25,410	20,538	16,800	14,112	16,170	16,800	17,514	25,116	29,316	35,658	36,456	34,860	288,750
Louisiana-Arkansas:													
Louisiana Gulf coast	630	840	714	1,092	798	672	1,470	1,512	1,596	1,218	1,050	924	12,516
Arkansas and Louisiana inland	1,344	798	1,050	1,134	1,092	1,050	1,470	1,806	2,100	2,394	2,058	2,058	18,354
Total, Louisiana and Arkansas	1,974	1,638	1,764	2,226	1,890	1,722	2,940	3,318	3,696	3,612	3,108	2,982	30,870
Rocky Mountain	2,646	3,024	2,982	2,646	2,268	1,974	1,974	2,100	2,982	3,990	5,670	3,864	36,120
California [1]	29,862	28,350	30,240	32,676	34,272	44,478	41,286	42,084	45,066	54,600	43,092	42,336	468,342
Total, United States	102,396	90,510	85,050	82,278	82,866	93,156	94,794	107,814	123,354	156,114	145,740	138,978	1,303,050
1936 [2]													
East coast	5,292	2,142	2,688	1,470	1,470	1,722	4,578	3,234	4,578	6,468	7,350	7,896	48,888
Appalachian	1,218	924	1,092	882	714	882	714	798	756	1,092	1,596	1,722	12,390
Indiana, Illinois, Kentucky, etc	14,994	12,894	14,112	11,130	11,004	9,240	9,660	9,828	13,356	17,934	16,716	17,304	158,172
Oklahoma, Kansas, and Missouri	25,158	18,564	17,010	17,724	16,506	17,850	20,370	22,890	26,460	30,156	29,190	25,494	267,372
Texas:													
Gulf coast	11,172	9,240	7,476	6,174	8,064	8,358	14,112	14,280	20,832	24,276	26,166	20,202	170,352
Inland	17,304	11,382	11,928	9,660	8,400	12,432	15,330	16,758	19,362	21,546	21,042	20,748	185,892
Total, Texas	28,476	20,622	19,404	15,834	16,464	20,790	29,442	31,038	40,194	45,822	47,208	40,950	356,244
Louisiana-Arkansas:													
Louisiana Gulf coast	1,428	1,302	1,176	630	756	756	924	1,008	840	1,176	1,806	1,722	13,524
Northern Louisiana and Arkansas	1,890	1,428	1,512	1,302	1,554	1,890	2,352	2,394	2,394	2,604	2,058	2,352	23,730
Total, Louisiana and Arkansas	3,318	2,730	2,688	1,932	2,310	2,646	3,276	3,402	3,234	3,780	3,864	4,074	37,254
Rocky Mountain	4,368	3,402	2,646	2,688	2,268	2,016	2,058	2,058	2,310	4,746	5,166	4,914	38,640
California [1]	38,598	32,634	42,798	35,910	33,642	33,768	40,698	47,670	49,434	47,460	48,846	49,896	501,354
Total, United States	121,422	93,912	102,438	87,570	84,378	88,914	110,796	120,918	140,322	157,458	159,936	152,250	1,420,314

[1] Includes natural gasoline run through pipe lines.

[2] Preliminary.

"Direct" sales.—Data on "direct" sales, that is, domestic movement to consumers other than refineries, are important as they reflect the extent to which the manufacturers depend upon refinery sales and indicate the use of stabilized natural gasoline as a fuel without blending. Such sales increased in quantity from 116,340,000 gallons in 1935 to 139,230,000 gallons in 1936 and in percentage of total domestic sales, from 8 to 9 percent. The gain would probably have been even larger if prices paid by the refiners had not stiffened.

"Direct" sales are made to virtually every State, but most of the gasoline so sold moves northward from Texas and Oklahoma. Texas continued to be the largest "direct" shipper but was closely pressed by Oklahoma. The largest interstate movement of this type in 1936 was that from Oklahoma to Illinois.

Pipe-line shipments.—The movement of natural gasoline by pipe line in California increased from 31,290,000 gallons in 1935 to 52,500,000 in 1936. Comparable data are lacking for the rest of the country in 1936, but the total quantity moved is believed to have increased.

Shipments of natural gasoline to jobbers, retailers, and refinery-owned bulk plants in 1936,[1] by States

[Thousands of gallons]

Point of delivery	Point of receipt							Total
	Texas	Illinois	Oklahoma	Minnesota	Ohio	Wisconsin	Other	
Texas	15,720	1,406	129	5,037	503	3,341	9,216	35,352
Oklahoma	557	10,168	8,858	4,590	688	3,189	6,792	34,842
West Virginia					5,995		13,063	19,058
Arkansas							7,810	7,810
Pennsylvania					1,199		3,609	4,808
Ohio					4,082		540	4,622
Other	678	815	1,091	492	1,992	527	27,143	32,738
	16,955	12,389	10,078	10,119	14,459	7,057	68,173	139,230

[1] Preliminary.

Water-borne shipments.—According to data reported to the Bureau of Mines by manufacturers, exports of natural gasoline totaled 107,058,000 gallons in 1936 compared with 135,366,000 gallons in 1935. The Bureau of Foreign and Domestic Commerce reports natural-gasoline exports for 1936 as 1,807,000 barrels (75,894,000 gallons); the disparity of about 30,000,000 gallons between the two figures was probably due to differences in classifying exports of gasoline and natural gasoline.

The only other important water-borne movement of natural gasoline is that from the Texas Gulf to the East coast. Complete data on this movement are not available, but refinery deliveries to the East coast, most of which came from the Gulf by tanker, were reported as only 37,918,000 gallons in 1936 compared with 61,109,000 gallons in 1935.

Exports of natural gasoline to Canada, most of which probably moved in tank cars, totaled about 29,000,000 gallons in 1936 compared with about 20,000,000 gallons in 1935.

STOCKS

In 1935 stocks of natural gasoline declined about 22,000,000 gallons—from 177,086,000 gallons at the beginning of the year to 155,316,000 gallons at the close. In 1936 the trend was reversed, and stocks increased about 15,000,000 gallons to a total of 170,310,000 gallons on December 31, 1936. As the improvement in prices in 1935 was held to be related to the decline in stocks during the year, it seems unusual that prices continued to improve in 1936 with rising stocks. However, most of the net increase in stocks in 1936 was registered late in the year in California; stocks in the Midcontinent district, where most price movements originate, were probably consistently lower in 1936 than in 1935.

Stocks of natural gasoline, 1935–36, by months

[Thousands of gallons]

Date	At refineries				At plants and terminals				Total	
	California		Other States		Texas		Other States		1935	1936 [1]
	1935	1936 [1]	1935	1936 [1]	1935	1936 [1]	1935	1936 [1]		
Jan. 1	98,490	62,790	22,470	23,436	29,715	48,289	26,411	20,801	177,086	155,316
Jan. 31	108,948	71,610	22,050	20,496	34,020	51,105	27,324	22,101	192,342	165,312
Feb. 28	109,788	[2] 79,002	29,190	[2] 21,168	31,108	[2] 48,589	30,729	[2] 28,397	200,815	[2] 177,156
Mar. 31	118,356	76,398	25,452	23,604	40,767	54,492	33,892	36,732	218,467	191,226
Apr. 30	118,944	77,616	29,568	23,898	53,211	69,612	32,871	41,310	234,594	212,436
May 31	114,618	87,486	28,098	26,670	67,025	75,802	41,296	47,930	251,037	237,888
June 30	103,026	91,770	29,526	28,182	70,972	73,651	44,317	51,215	247,841	244,818
July 31	90,930	92,190	26,208	30,660	82,283	72,428	44,858	50,254	244,279	245,532
Aug. 31	86,310	88,998	25,116	32,802	76,750	66,378	48,200	49,248	236,376	237,426
Sept. 30	74,550	84,588	25,116	33,684	74,841	48,045	41,079	41,373	215,586	207,690
Oct. 31	61,236	79,842	20,328	41,412	68,513	42,216	34,051	27,840	184,128	191,310
Nov. 30	60,606	77,658	22,344	31,080	51,426	41,070	30,264	24,618	164,640	174,426
Dec. 31	62,790	75,768	23,436	25,914	48,289	45,423	20,801	23,205	155,316	170,310

[1] Preliminary. [2] As of Feb. 29.

TECHNICAL DEVELOPMENTS

Yields.—No startling technical developments were made in natural-gasoline manufacture in 1935 or 1936. The average yield, which increased from 0.86 gallon per thousand cubic feet in 1934 to 0.91 gallon in 1935, probably increased still further in 1936. These gains may reflect the addition of improved equipment and the elimination of many small inefficient plants, but probably they reflect chiefly the rise in importance of East Texas, a high-yield area, and the decline in importance of the Panhandle, a low-yield area.

Production by processes.—Although absorption continued to be the principal means of producing gasoline the compression process made a notable come-back in 1935, when the total output at plants using that process rose to 180,953,000 gallons from 148,150,000 gallons in 1934. Similar data are not available for 1936, but undoubtedly compression production increased further as the output in East Texas, where the process is popular, increased materially.

Even the charcoal process, production from which had been declining since 1929 and which appeared due for early extinction, held its own in 1935.

Natural gasoline produced in the United States in 1935, by States and by methods of manufacture

State	Number of plants operating			Production (thousands of gallons)		
	Compression	Absorption [1]	Charcoal	Compression	Absorption [1]	Charcoal
Arkansas	1	7		1,695	11,381	
California	2	89		2,446	532,178	
Colorado	1	1		228	189	
Illinois	65			2,642		
Kansas	5	14		1,828	30,679	
Kentucky	1	3	1	40	5,056	518
Louisiana	6	20		4,415	45,317	
Michigan	2			1,850		
Montana		1			1,739	
New Mexico		2			19,563	
New York	1			27		
Ohio	4	6	1	51	5,119	1,062
Oklahoma	50	112		53,106	326,807	
Pennsylvania	88	18	1	3,145	9,311	167
Texas	29	94		72,652	444,096	
West Virginia	55	19	7	11,926	24,344	6,163
Wyoming	2	7		24,902	7,344	
Total, 1935	312	393	10	180,953	1,463,123	7,910
Total, 1934	344	411	11	148,150	1,379,648	7,562

[1] Includes combination of absorption process with compression and charcoal processes.

Trends in vapor pressures.—The average vapor pressure of production in 1936 was about 20.25 pounds (Reid), or 0.25 pound higher than in 1935. This gain probably was related to the increase in yield, as yields and vapor pressures generally vary directly. The usual seasonal trend in vapor pressures was evidenced in 1936; the high (21.5) was in January and February and the low (18.6) in July. The average vapor pressure of refinery shipments rose from 20.5 pounds in 1935 to 20.9 pounds in 1936, but the average for "direct" shipments declined from 16.1 to 15.9 pounds and that for exports from 18.7 to 17.4 pounds.

Polymerization.—In Minerals Yearbook, 1936, the development of polymerization as a process to convert natural gas into high-octane gasoline was mentioned. Undoubtedly some progress was made along these lines in 1936, although in the natural-gasoline industry the work was probably mainly research.

LIQUEFIED PETROLEUM GASES

Domestic sales of liquefied petroleum gases continued to increase rapidly and in 1936 totaled 106,652,000 gallons, or 39 percent higher than in 1935. Exports also rose—from 4,237,000 gallons in 1935 to 4,897,000 gallons in 1936. The increase in sales in 1936 appears to have resulted from a general expansion; butane and propane, the two most important kinds of gas, maintained their relative positions, and the division between domestic or "bottled-gas" sales and industrial uses remained virtually unchanged.

Marketed production of liquefied petroleum gases in the United States, 1922–36

Year	Gallons	Year	Gallons	Year	Gallons	Year	Gallons
1922	222,641	1926	465,085	1930	18,017,347	1934	[1] 56,427,000
1923	276,863	1927	1,091,005	1931	28,769,576	1935	76,855,000
1934	376,488	1928	4,522,899	1932	34,114,767	1936	106,652,000
1925	403,674	1929	9,930,964	1933	38,931,008		

[1] Revised figures.

The economic history of the liquefied-gas industry in 1936 has been summarized as follows:[2]

A review of the market requirements for the various liquefied gases shows that sales of propane increased from 26,814,000 gallons in 1935 to 36,502,000 gallons in 1936, a gain of 36.1 percent. Deliveries of butane, which are larger in volume than any of the other liquefied petroleum gases, increased to 47,455,000 gallons in 1936, or 39.2 percent over the 1935 total of 34,084,000 gallons. Sales of propane-butane mixtures, ranking third in relative volume, gained 49.1 percent in 1936. The demand for pentane in 1936 was limited to 2,575,000 gallons, a quantity only slightly above the 1935 deliveries.

The industrial use of liquefied petroleum gases totaled 47,894,000 gallons in 1935 and constituted 62.3 percent of the market demand, while the comparative total for 1936 is 67,267,000 gallons or 63.1 percent of all deliveries. A tabulation of sales records, as reported to the Bureau of Mines, shows that the 1936 total is divided as follows: Industrial fuel 40,140,000 gallons, chemical manufacturing 14,445,000 gallons, internal-combustion-engine fuel 12,476,000 gallons, and miscellaneous uses 206,000 gallons. The item covering the use of liquefied petroleum gases for motor fuel is of special interest, as it is the first time that this demand has been segregated in this annual survey. Sales of liquefied petroleum gases for domestic or "bottled gas" purposes accounted for 28.1 percent of the total demand in 1936. The quantity reported under this classification is 30,014,000 gallons, a gain of 40.4 percent over 1935 deliveries. Liquefied petroleum gases purchased by gas companies showed an increase of 23.6 percent in 1936, totaling 9,371,000 gallons compared with 7,581,000 gallons in 1935.

Propane, because of its high volatility, is sold principally for domestic purposes, or for cooking and lighting in homes where gas from gas-company mains is not available. This demand of 24,423,000 gallons accounted for two-thirds of the total sales of propane in 1936. Propane is of secondary importance as an industrial fuel, and a small amount is used as a raw material in chemical manufacturing. Sales of propane for industrial fuel and chemical use were reported as 11,030,000 gallons in 1936. Less than 1 million gallons of propane were purchased by gas-manufacturing companies in 1936. Butane, less volatile than propane, has a higher B. t. u. value per gallon, hence it is used chiefly as an industrial fuel, there being 28,553,000 gallons of butane (60.2 percent of total deliveries) sold under this caption in 1936, including a small quantity going to chemical plants for raw material. Distributors reported that 9,622,000 gallons of butane were used as fuel in internal-combustion engines in 1936, a demand confined largely to the Pacific Coast area. Deliveries of butane to gas companies, which declined from 5,064,000 gallons in 1934 to 5,042,000 gallons in 1935, registered a gain in 1936, when a total of 6,227,000 gallons was reported under this classification. Domestic uses of butane increased over 100 percent in 1936, showing 2,956,000 gallons compared with 1,353,000 gallons in 1935. Propane-butane mixtures are sold largely to chemical plants for raw material, and a minor quantity is consumed as industrial fuel. The domestic and the gas-manufacturing demand, respectively, for propane-butane mixtures was approximately 2 million gallons in 1936, while about 2,700,000 gallons were sold for motor fuel in the same period.

The American Gas Association has supplied the following review regarding plants distributing liquefied petroleum gases in the United States in 1936.

"At the end of 1936, liquefied petroleum gas was being delivered through mains to consumers in 178 communities in 30 States by 72 companies supplying 31,300 customers.

Butane-air gas with heating value ranging from 520 to 900 B. t. u. per cu. ft. was supplied to 124 communities in 28 States by 60 companies.

[2] Coumbe, A. T., Sales of Liquefied Petroleum Gases Continue to Expand in 1936: Min. Market Rept. 543, Bureau of Mines, 1937, 4 pp.

A mixture of undiluted butane and propane gas with a heating value of 2,800 to 3,000 B. t. u. per cu. ft. was supplied to 14 communities in California and Nevada by 6 companies. Undiluted propane gas with a heating value of 2,550 B. t. u. per cu. ft. was supplied to 40 communities in Maryland, Minnesota, New Jersey, North Dakota, Virginia, and Wisconsin by 6 companies."

Bulk shipments totaled 82,575,000 gallons in 1936 or 77.4 percent of the total movement of liquefied petroleum gases into consumption, compared with 61,457,000 gallons or 80.0 percent of the 1935 marketed demand. Cylinder and drum deliveries were relatively greater in 1936, 22.6 percent of the liquefied-petroleum-gas sales being handled in these containers compared with 20.0 percent in 1935. The volume of cylinder shipments increased from 15,398,000 gallons in 1935 to 24,077,000 gallons in 1936.

There were 32 distributors who reported their 1936 sales of liquefied petroleum gases to the Bureau of Mines compared with 30 who cooperated in the 1935 study. Eleven out of the 1936 total operated in the Pacific Coast area.

Marketed production of liquefied petroleum gases by uses, methods of transportation, and regional distribution, 1935–36

[Thousands of gallons]

	Propane	Butane	Propane-butane mixtures	Pentane	Total	Percent of total
1935						
Uses:						
Domestic	18,325	1,353	[1] 1,702	(1)	21,380	27.8
Gas manufacturing	702	5,042	[1] 1,837	(1)	7,581	9.9
Industrial fuel and chemical manufacturing; Internal-combustion-engine fuel; All other uses	7,787	27,689	[1] 12,418	(1)	47,894	62.3
	26,814	34,084	13,493	2,464	76,855	100.0
Percent of total	34.9	44.3	17.6	3.2	100.0	
Method of transportation:						
Bulk	13,394	33,805	[1] 14,258	(1)	61,457	80.0
Cylinders and drums	13,420	279	[1] 1,699	(1)	15,398	20.0
	26,814	34,084	[1] 15,957	(1)	76,855	100.0
Regional distribution:						
Pacific Coast area	(2)	(2)	(2)	(2)	17,678	23.0
All other areas	(2)	(2)	(2)	(2)	59,177	77.0
	(2)	(2)	(1)	(2)	76,855	100.0
1936						
Uses:						
Domestic	24,423	2,956	2,048	587	30,014	28.1
Gas manufacturing	944	6,227	2,200		9,371	8.8
Industrlia fuel and chemical manufacturing	11,030	28,553	13,122	1,880	54,585	51.2
Internal-combustion-engine fuel	105	9,622	2,749		12,476	11.7
All other uses		97	1	108	206	.2
	36,502	47,455	20,120	2,575	106,652	100.0
Percent of total	34.2	44.5	18.9	2.4	100.0	
Method of transportation:						
Bulk	16,319	46,520	17,289	2,447	82,575	77.4
Cylinders and drums	20,183	935	2,831	128	24,077	22.6
	36,502	47,455	20,120	2,575	106,652	100.0
Regional distribution:						
Pacific Coast area	5,434	12,067	6,145		23,646	22.2
All other areas	31,068	35,388	13,975	2,575	83,006	77.8
	36,502	47,455	20,120	2,575	106,652	100.0

[1] Pentane included with propane-butane mixtures.
[2] Not available.

CARBON BLACK

By G. R. Hopkins and H. Backus

SUMMARY OUTLINE

The carbon-black industry experienced a record-breaking year in 1936, with new highs for production, domestic sales, and exports. (See fig. 79.) In addition stocks at the plants were reduced mate-

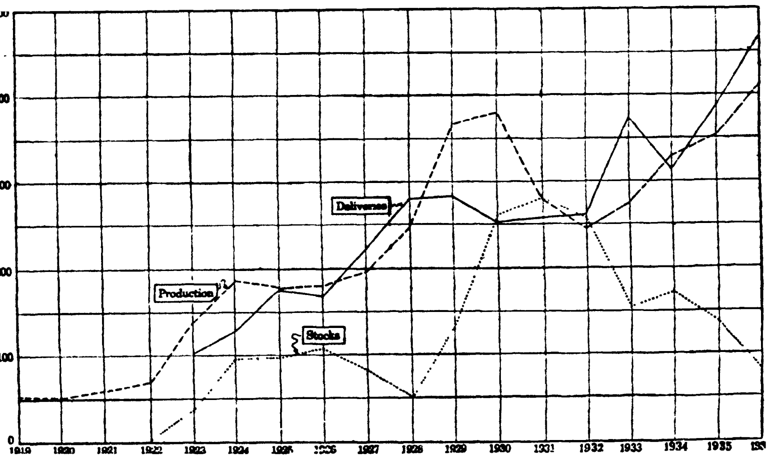


FIGURE 79.—Carbon-black production, stocks, and deliveries, 1919–36.

rially, reaching approximate working-stock levels at the close of the year. Prices remained remarkably uniform throughout the year; the average plant value increased slightly to just under 4 cents per pound, and the average export value remained unchanged at nearly 1 cent more. Threats to the prevailing stability were evidenced in repeated reports that consumers were storing stocks in anticipation of labor troubles and that the Texas Legislature was about to impose a heavy tax on carbon black. Anticipated increases in stocks based on the expectation of prolonged labor disturbances in the rubber industry failed to materialize, and the consensus of opinion was that the industry actually used most of its 30-percent increase in purchases (1936 over 1935) during 1936. The Texas Legislature imposed a tax of about 3 percent on carbon-black production late in the year, but this tax was partly neutralized by downward revisions in freight rates early in 1937.

Salient statistics for carbon black made from natural gas in the United States, 1932–36

	1932	1933	1934	1935	1936
Number of producers reporting	24	25	25	21	20
Number of plants	50	51	50	54	54
Quantity produced:					
By States and districts:					
Louisiana pounds	42,260,000	54,470,000	66,538,000	64,875,000	59,201,000
Texas:					
Breckenridge district do	[1] 23,071,000	[1] 24,499,000	[1] 24,887,000	[1] 24,513,000	12,330,000
Panhandle district do	177,369,000	194,156,000	237,403,000	263,361,000	321,576,000
Total Texas do	[1] 200,440,000	[1] 218,655,000	[1] 262,290,000	[1] 287,874,000	333,906,000
Other States do	(1)	(1)	(1)	(1)	18,238,000
Total United States do	242,700,000	273,125,000	328,828,000	352,749,000	411,345,000
By processes:					
Channel process do	224,536,000	238,026,000	293,546,000	316,284,000	366,876,000
Other processes [2] do	18,164,000	35,099,000	35,282,000	36,465,000	44,469,000
Stocks held by producers Dec. 31 pounds	257,998,000	155,969,000	171,799,000	136,086,000	79,582,000
Losses do	4,814,000	686,000	386,000	926,000	113,000
Quantity sold:					
Domestic:					
To rubber companies do	130,380,000	191,358,000	165,446,000	213,708,000	278,018,000
To ink companies do	18,341,000	18,539,000	16,146,000	15,177,000	17,787,000
To paint companies do	7,636,000	6,260,000	5,365,000	6,550,000	6,914,000
For miscellaneous purposes pounds	5,126,000	6,025,000	5,035,000	9,916,000	10,299,000
Total domestic sold do	161,483,000	222,182,000	191,992,000	245,351,000	313,018,000
Export do	100,072,000	152,286,000	120,620,000	142,185,000	154,718,000
Total sold do	261,555,000	374,468,000	312,612,000	387,536,000	467,736,000
Value (at plants) of carbon black produced:					
Total	$6,664,000	$7,602,000	$11,654,000	$13,755,000	$16,110,000
Average per pound cents	2.75	2.78	3.54	3.90	3.92
Estimated quantity of natural gas used M cubic feet	168,237,000	190,081,000	229,933,000	241,589,000	283,421,000
Average yield per M cubic feet pounds	1.44	1.44	1.43	1.46	1.45

[1] Oklahoma and Wyoming included with Breckenridge district, Texas.
[2] 1932–33: Disk, Lewis, roller, "special", and thermatomic; 1934–36: Lewis, roller, "special", and thermatomic.

PRODUCTION

Production, by States, districts, and months.—An increase in production of carbon black in Oklahoma and Wyoming was virtually offset by a decline in Louisiana; in other words, most of the 60,000,000-pound increase in national output was recorded in Texas, more specifically in the Texas Panhandle, which was credited with nearly 80 percent of the total production of the United States in 1936.

The competition of domestic demand for gas in Louisiana continued to restrict operations in that State, and production declined from 64,875,000 pounds in 1935 to 59,201,000 in 1936. A number of units in Louisiana were dismantled and moved to Texas; this is reflected in the decline from 19 operating plants in Louisiana in 1935 to 16 in 1936.

Although the center of the industry has been moving closer and closer to the Panhandle, primarily because of the comparative cheapness of the gas in that area, a possible spreading out of production in the not too distant future is indicated. First, the supply of residue gas from "stripper" plants in the Panhandle has been curtailed; and, second, production in Oklahoma and Wyoming, the other producing States, increased about 40 or 50 percent in 1936 over 1935.

Carbon black produced in the United States, 1927–36, by States

Year	Production (thousands of pounds)					Average value per pound (cents)
	Louisiana	Texas	West Virginia	Other States	Total	
1927	124,188	56,396	2,796	15,049	198,429	5.52
1928	136,320	100,828	697	10,945	248,790	5.54
1929	127,345	228,183	578	10,336	366,442	5.11
1930	96,729	271,749	(1)	11,464	379,942	3.91
1931	57,485	210,878		12,544	280,907	3.07
1932	42,260	[2] 200,440		(2)	242,700	2.75
1933	54,470	[2] 218,655		(2)	273,125	2.78
1934	66,538	[2] 262,290		(2)	328,828	3.54
1935	64,875	[2] 287,874		(2)	352,749	3.90
1936	59,201	333,906		[3] 18,238	411,345	3.92

[1] Included under "Other States."
[2] Oklahoma and Wyoming included with Texas
[3] Oklahoma and Wyoming.

Carbon black produced from natural gas in the United States, 1935–36, by States and by major producing districts

State and district	Producers reporting [1]	Number of plants	Production			Estimated quantity of natural gas used (M cubic feet)	Average yield per M cubic feet (pounds)
			Pounds	Value at plant			
				Total	Average (cents)		
1935							
Louisiana: Monroe-Richland district (Morehouse Ouachita and Richland Parishes)	10	19	64,875,000	$2,507,000	3.86	54,021,000	1.20
Oklahoma	1	1	(2)	(2)	(2)	(2)	(2)
Texas:							
Breckenridge district (Eastland and Stephens Counties)	4	5	[2] 24,513,000	[2] 996,000	[2] 4.06	[2] 12,567,000	[2] 1.95
Panhandle district (Carson, Gray, Hutchinson, and Wheeler Counties)	14	28	263,361,000	10,252,000	3.89	175,001,000	1.50
Total, Texas	[1] 14	33	[2] 287,874,000	[2] 11,248,000	[2] 3.91	[2] 187,568,000	[2] 1.53
Wyoming	1	1	(2)	(2)	(2)	(2)	(2)
Total United States	[1] 21	54	352,749,000	13,755,000	3.90	241,589,000	1.46
1936							
Louisiana: Monroe-Richland district (Morehouse, Ouachita, and Richland Parishes)	9	16	59,201,000	2,385,000	4.03	46,357,000	1.28
Oklahoma	2	2	[3] 18,238,000	[3] 722,000	[3] 3.96	[3] 8,778,000	[3] 2.08
Texas:							
Breckenridge district (Eastland and Stephens Counties)	4	5	12,330,000	510,000	4.14	5,440,000	2.27
Panhandle district (Carson, Gray, Hutchinson, Moore, and Wheeler Counties)	14	30	321,576,000	12,493,000	3.88	222,846,000	1.44
Total, Texas	[1] 14	35	333,906,000	13,003,000	3.89	228,286,000	1.46
Wyoming	1	1	(3)	(3)	(3)	(3)	(3)
Total, United States	[1] 20	54	411,345,000	16,110,000	3.92	283,421,000	1.45

[1] In counting the total number of producers, a producer operating in more than 1 State, district, or county is counted only once.
[2] Oklahoma and Wyoming included with Breckenridge district, Texas.
[3] Oklahoma includes Wyoming.

Carbon black produced in the United States in 1936, by months, in pounds

Month	National Gas Products Association	Bureau of Mines[1]		Month	National Gas products Association	Bureau of Mines[1]	
		Total	Daily average			Total	Daily average
January	30,909,000	33,895,000	1,094,000	August	33,467,000	36,692,000	1,184,000
February	26,781,000	29,370,000	1,013,000	September	31,868,000	34,965,000	1,166,000
March	30,193,000	33,113,000	1,068,000	October	33,002,000	36,198,000	1,168,000
April	30,106,000	33,031,000	1,101,000	November	32,374,000	35,499,000	1,183,000
May	30,413,000	33,360,000	1,076,000	December	34,369,000	37,720,000	1,217,000
June	29,263,000	32,085,000	1,070,000				
July	32,296,000	35,417,000	1,142,000		375,041,000	411,345,000	1,124,000

[1] Monthly figures obtained by allocating the Bureau's annual total proportionately to the Association's monthly data.

According to estimates based on the monthly figures of the National Gas Products Association, the output of carbon black increased more or less steadily in 1936, reaching nearly 38,000,000 pounds in December.

Methods and yields.—Although the channel process continued to be the primary method of manufacturing carbon black, there was a slight gain in the relative importance of the "other processes" in 1936. Thus the output of channel black increased from 316,284,000 pounds in 1935 to 366,876,000 in 1936, a gain of 16 percent, whereas production by other processes, the Lewis, roller, "special", and thermatomic, increased from 36,465,000 pounds in 1935 to 44,469,000 in 1936, or 22 percent.

Number and daily capacity of carbon-black plants operated in the United States, 1935–36, by counties or parishes

State	County or parish	Number of plants		Total daily capacity (pounds)	
		1935	1936	1935	1936
Louisiana	Morehouse	5	4	68,850	32,550
	Ouachita	13	11	252,775	255,275
	Richland	1	1	14,000	3,500
		19	16	335,625	291,325
Oklahoma	Beckham	(1)	1	(1)	(2) 74,400
	Seminole		1		
		(1)	2	(1)	(2) 74,400
Texas	Carson	2	2	(3) 111,000	(3) 196,000
	Eastland	1	1	(1)	(4)
	Gray	9	9	333,400	333,400
	Hutchinson	14	14	571,300	495,670
	Moore		2		(3)
	Stephens	(1) 5	4	(1) 100,800	(4) 41,300
	Wheeler	3	3	(3)	(3)
		(1) 34	35	(1) 1,116,500	1,066,370
Wyoming	Niobrara	1	1	(1)	(2)
United States		54	54	1,452,125	1,432,095

[1] Oklahoma, Wyoming, and Eastland County, Tex., included with Stephens County, Tex.
[2] Oklahoma includes Wyoming.
[3] 1935: Carson County includes Wheeler County; 1936: Carson County includes Moore and Wheeler Counties.
[4] Eastland County included with Stephens County.

Carbon-black manufacture continued to account for a material part of the total consumption of natural gas; the quantity burned in 1936

(283,421,000,000 cubic feet) comprised about 13 percent of the estimated total consumption, the same ratio as in 1935. Although the gain in production of carbon black by "other processes" usually indicates an increase in output of high-yield retort blacks and hence a gain in the national yield, the reverse held true in 1936, and the average yield declined from 1.46 to 1.45 pounds per thousand cubic feet.

Number and capacity of plants.—Despite continuation of stable economic conditions the total number of plants remained 54 in 1936, the same as in 1935. A loss of three plants in Louisiana was balanced by the addition of two in the Panhandle and the renewal of operations at one in Oklahoma. The concentration of plants among fewer operators continued in 1936, when there were only 20 compared with 21 in 1935 and 25 in 1934.

Apparently all the units dismantled in Louisiana were not set up in the Panhandle, as the total daily capacity of all plants declined from 1,452,125 pounds in 1935 to 1,432,095 in 1936. This decline in capacity plus the increase in output, indicates an advance in the operating ratio (daily production divided by daily capacity) from 67 percent in 1935 to the comparatively high point of 78 percent in 1936.

Producers.—The reported changes in the list of carbon-black producers were as follows: The Keystone Carbon Co. and the Texas-Louisiana Producing & Carbon Co. went out of business in Louisiana; the Cabot Carbon Co. renewed operations in Oklahoma; the Columbian Carbon Co. took over the Western Carbon Co.; and the Reliance Carbon Co., Inc., began operations in Texas.

Carbon-black producers of the United States, as of Dec. 31, 1936

State and company	County	Nearest town	Process
Louisiana:			
J. M. Huber Corporation, care of J. M. Huber, Inc., 460 West 34th St., New York, N. Y.	Ouachita	Swartz	Channel.
Imperial Oil & Gas Products Co., 1220 Grant Bldg., Pittsburgh, Pa.	do	Sterlington	Do.
C. Eneu Johnson & Co., Route 2, Bastrop, La.	Morehouse	Bastrop	Do.
Monroe-Louisiana Carbon Co., 41 East 42d St., New York, N. Y.	Ouachita	Hancock	Lewis.
Peerless Carbon Black Co., 3003 Grant Bldg., Pittsburgh, Pa.	do	Bourland	"Special."
Southern Carbon Co., 41 East 42d St., New York, N. Y.	Morehouse	Perryville	Channel.
	Ouachita	Fowler	Do.
	do	Swartz	Do.
Thermatomic Carbon Co., 230 Park Ave., New York, N. Y.	do	Sterlington	Thermatomic.
United Carbon Co., Inc., 901 Union Bldg., Charleston, W. Va.	Morehouse	Dewdrop	Channel.
	Ouachita	Phillips	Do.
	do	Swartz	Do.
	Richland	Archibald	Do.
Oklahoma:			
Cabot Carbon Co., 77 Franklin St., Boston, Mass.	Seminole	Wewoka	Do.
United Carbon Co, Inc., 901 Union Bldg., Charleston, W. Va.	Beckham	Sayre	Do.
Texas:			
Cabot Carbon Co., 77 Franklin St., Boston, Mass.	Gray	Pampa	Do.
	Hutchinson	Stinnett	Do.
Cabot Co., 77 Franklin St., Boston, Mass.	Carson	Skellytown	Channel and roller.
Coltexo Corporation, 41 East 42d St., New York, N. Y.	Gray	Lefors	Channel.
	Stephens	Parks	Do.
Columbian Carbon Co., 41 East 42d St., New York, N. Y.	Gray	Kingsmill	Do.
	do	Lefors	Do.
	do	Pampa	Do.
	Hutchinson	Borger (2 plants)	Do.
	Moore	Sunray	Do.
	Wheeler	Lela	Do.
	do	Magic City	Do.
Combined Carbon Co., 901 Union Bldg., Charleston, W. Va.	Hutchinson	Sanford	Do.

Carbon-black producers of the United States, as of Dec. 31, 1936—Continued

State and company	County	Nearest town	Process
Texas—Continued.			
Crescent Carbon Co., Point Pleasant, W. Va.	Hutchinson	Borger	Channel.
General Atlas Chemical Co., 60 Wall St., New York, N. Y.	Gray	Pampa	"Special."
J. M. Huber Corporation, care of J. M. Huber, Inc., 460 West 34th St., New York, N. Y.	Carson	Skellytown	Channel.
	Hutchinson	Borger	Do.
Magnolia Petroleum Co., P. O. Box 900, Dallas, Tex.	Gray	Pampa	Do.
	Wheeler	Magic City	Do.
Panhandle Carbon Co., 295 Madison Ave., New York, N. Y.	Hutchinson	Borger	Do.
Peerless Carbon Black Co., 3003 Grant Bldg., Pittsburgh, Pa.	Eastland	Pioneer	"Special."
	Gray	Pampa	Do.
Reliance Carbon Co., Inc., 901 Union Bldg., Charleston, W. Va.	Moore	Sunray	Channel.
Texas Elf Carbon Co., 77 Franklin St., Boston, Mass.	Gray	Pampa	Do.
	Stephens	Eliasville	Do.
United Carbon Co., Inc., 901 Union Bldg., Charleston, W. Va.	Hutchinson	Borger (4 plants)	Do.
	do	Sanford (2 plants)	Do.
	do	Stinnett	Do.
	Stephens	Breckenridge (2 plants).	Do.
Wyoming: J. M. Huber Corporation, care of J. M. Huber, Inc., 460 West 34th St., New York, N. Y.	Niobrara	Manville	Do.

DEMAND

Total deliveries.—The demand for carbon black continued in record-breaking proportions in 1936, as the equivalent of all the record output

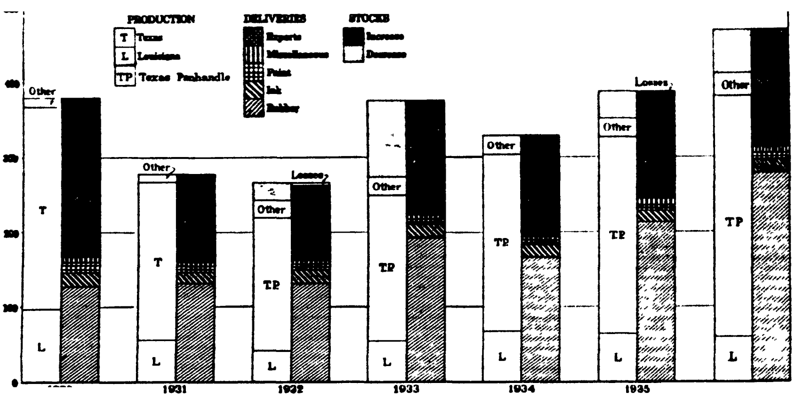


FIGURE 80.—Production and consumption of carbon black, 1930–36.

was sold, and in addition substantial amounts were withdrawn from stocks. Total sales rose from 387,536,000 pounds in 1935 to 467,736,000 in 1936, a gain of 21 percent; of the latter, 313,018,000 pounds (67 percent) were sold in the United States and 154,718,000 pounds (33 percent) exported. Although exports reached a new high level in 1936, their percentage of total sales declined.

Domestic consumption.—Of total domestic sales in 1936, 278,018,000 pounds (89 percent) were consigned to rubber companies, 17,787,000 pounds (6 percent) to ink companies, 6,914,000 pounds (2 percent) to paint companies, and 10,299,000 pounds (3 percent) to companies producing miscellaneous products. These data indicate a continued increase in the importance of the rubber trade for, although sales to each of the other three classes increased in 1936 compared with 1935, their respective percentages of total domestic sales dropped. (See fig. 80.)

In accounting for the 30-percent gain in indicated demand by the rubber trade for carbon black, E. G. Holt of the Bureau of Foreign and Domestic Commerce has kindly supplied pertinent rubber statistics. According to Holt, the total consumption of crude and reclaimed rubber in the United States increased from 609,000 long tons in 1935 to 708,000 in 1936, a gain of 16 percent; of the latter figure, 575,000 long tons was crude rubber and 133,000 reclaimed rubber. The output of automobile casings, which showed a comparative lag in 1935, increased materially in 1936, when production was 58,098,000, or 19 percent higher than in 1935. Sales of motor vehicles increased from 3,946,934 in 1935 to 4,454,535 in 1936, a gain of 13 percent.

The material increase in the production of casings and the consumption of crude rubber in 1936 over 1935 accounts for the major portion of the 30-percent gain in sales of carbon black to rubber companies. Part of the remainder might be accounted for by increases in consumers' stocks, although the most likely explanation is that the average size of casings continued to increase. The production of tires with white-rubber sides may have increased, although it is doubtful if this development appreciably affected the average consumption of carbon black per casing.

According to Holt, the apparent consumption of crude rubber in the world was 1,051,000 long tons in 1936, a gain of 12 percent over 939,000 long tons in 1935; as the gain in the United States was 17 percent in the same period, the paramount position of this country in the use of rubber was necessarily somewhat strengthened.

Sales of carbon black to ink companies increased from 15,177,000 pounds in 1935 to 17,787,000 in 1936, or 17 percent. This advance reflects chiefly the gain of 12 percent in domestic consumption of newsprint reported by the Bureau of Foreign and Domestic Commerce as 3,272,000 short tons in 1935 and 3,658,000 in 1936.

Sales of carbon black to paint companies rose from 6,550,000 pounds in 1935 to 6,914,000 in 1936, or 6 percent. Data for 1936 on the production of black paints are lacking, but it may safely be concluded that this branch of the paint industry shared the general pick-up in business, in which the increased use of carbon black by the automotive industry played a prominent part.

Sales of carbon black for miscellaneous purposes, which increased unaccountably in 1935, advanced farther in 1936, when the total was 10,299,000 pounds compared with 9,916,000 pounds the preceding year.

The loss of carbon black incurred in handling at the plants was a negligible factor in distribution in 1936; only 113,000 pounds were so reported.

Exports and imports.[1]—Exports of carbon black established a new high record in 1936, when 154,718,398 pounds were shipped abroad, compared with 142,184,802 pounds in 1935 and 152,286,178 in 1933, the previous peak. The declared value of exports in 1936 was $7,250,704, an average of 4.69 cents per pound, the same average as in 1935.

The United Kingdom continued to purchase the largest amount of carbon black from the United States; in 1936 it took 46,956,730 pounds compared with 38,982,227 in 1935. France and Germany again exchanged rank as purchasers; exports to France increased

[1] Figures on exports and imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

about 7,000,000 pounds to nearly 27,000,000 pounds in 1936, and exports to Germany declined about 7,000,000 pounds to just over 16,000,000. Exports to Italy, another nation that has been increasing its stocks of tires as part of its defense program, declined materially in 1936, but exports to Japan continued to increase. The monthly record of exports in 1936, like that for production, trended upward, with the largest monthly total, 18,735,875 pounds, in December. Exports followed much the same domestic channels in 1936 as in 1935; Galveston consolidated its position as the leading shipping port, and New Orleans continued to outrank the Michigan customs district for second place.

Carbon black exported from the United States, 1934-36, by countries

Country	1934		1935		1936	
	Pounds	Value	Pounds	Value	Pounds	Value
Argentina	1, 602, 208	$79, 294	2, 413, 526	$125, 567	2, 214, 415	$120, 858
Australia	7, 821, 796	398, 230	6, 192, 367	271, 932	7, 525, 575	365, 178
Belgium	3, 451, 426	164, 166	3, 916, 519	241, 919	4, 791, 552	216, 690
Canada	11, 669, 472	517, 247	12, 475, 487	559, 397	14, 131, 366	634, 911
China	1, 052, 287	55, 835	1, 243, 204	63, 023	1, 998, 145	97, 202
France	22, 725, 781	1, 016, 457	19, 000, 182	954, 243	26, 747, 904	1, 195, 879
Germany	16, 499, 442	706, 348	23, 105, 613	982, 262	16, 225, 511	733, 491
Italy	4, 475, 344	220, 830	9, 335, 512	437, 541	5, 208, 663	239, 276
Japan	3, 464, 300	155, 445	8, 001, 036	363, 450	10, 918, 380	519, 919
Netherlands	1, 929, 661	85, 144	4, 674, 562	206, 623	2, 789, 979	133, 973
Spain	1, 206, 495	61, 879	2, 204, 538	110, 154	1, 239, 449	59, 476
United Kingdom	37, 696, 893	1, 694, 220	38, 982, 227	1, 771, 123	46, 956, 730	2, 163, 893
Other	7, 025, 114	386, 048	10, 640, 029	585, 782	13, 970, 729	769, 958
	120, 620, 219	5, 541, 143	142, 184, 802	6, 673, 016	154, 718, 398	7, 250, 704

Carbon black exported from the United States in 1936, by months and districts

Month	Pounds	Value	District	Pounds	Value
January	11, 315, 683	$519, 051	Buffalo	271, 557	$19, 977
February	12, 294, 922	559, 764	Galveston	85, 668, 446	3, 905, 402
March	13, 347, 884	611, 077	Los Angeles	1, 128, 685	68, 640
April	11, 212, 920	530, 771	Michigan	13, 317, 782	590, 449
May	12, 842, 718	586, 226	New Orleans	43, 662, 886	2, 057, 919
June	14, 220, 794	680, 476	New York	984, 479	83, 155
July	10, 141, 138	480, 728	Philadelphia	109, 799	8, 942
August	12, 544, 243	607, 420	Sabine	3, 513, 782	189, 159
September	11, 401, 823	562, 658	St. Lawrence	96, 372	3, 541
October	13, 441, 575	622, 861	San Francisco	3, 176, 727	141, 470
November	13, 218, 823	602, 184	Vermont	197, 925	9, 791
December	18, 735, 875	887, 488	Other districts	2, 589, 958	172, 059
	154, 718, 398	7, 250, 704		154, 718, 398	7, 250, 704

Imports of "gas black and carbon black", as reported by the Bureau of Foreign and Domestic Commerce, totaled only 120 pounds valued at $8 in 1936; and imports of acetylene black, superior to carbon black in certain uses, totaled 1,162,215 pounds valued at $119,564.

STOCKS

Stocks of carbon black at the plants, which rose to unwieldy proportions from 1929 to 1931, were reduced materially in 1936 in spite of the record-breaking output. During 1936 stocks declined from 136,086,000 to 79,582,000 pounds, at which point they represented

only about a 2-month supply. Data on consumers' and brokers' stocks are not available, but it is doubtful if either class increased materially, in spite of threats of serious labor troubles. However, stocks of carbon black did accumulate as finished goods in 1936, as the number of casings in storage increased approximately 4,000,000 during the year.

PRICES AND VALUES

Carbon-black prices changed little in 1936; the average plant value increased only 0.02 cent per pound over 1935, and with two minor exceptions prices for the various zones and grades established under the code remained unchanged. The average value at the plants in 1936 was 3.92 cents per pound compared with 3.90 cents in 1935. In response to inquiries as to what this plant value covers, the Bureau requested producers to give their definitions in reporting for 1936. Although the replies varied considerably, depending on how the charges for freight, special crating, commissions, and discounts were handled, it appears that virtually all producers reported on the basis of average delivery price minus average freight and that most of them deducted unusual expenses, such as export packing costs. Additional attempts will be made to obtain uniformity in reporting plant values.

Quoted prices on various grades of carbon black, 1935–36, in cents per pound

[Oil, Paint, and Drug Reporter]

Date	Standard rubber, ink, and paint qualities (car lots)							Special grades for varnishes, lacquers, and enamels (cases delivered)						
	Zone [1]							Grade						
	A	B	C	D	E	F	G	1	2	3	4	5	6	7
1935. Jan. 1	4.45	4.75	4.90	4.90	5.05	5.35	5.30	9.0	12.0	16.5	32.0	44.0	65.0	110.0
1936:														
Aug. 31	------	------	----	----	------	------	4.55	------	------	------	------	------	------	------
Sept. 7	------	------	------	------	------	------	------	------	------	------	------	------	60.0	------

[1] Zone A: Gulf coast ports: Galveston, Houston, Port Arthur, New Orleans, etc.; for coastwise delivery in North America.
Zone B: Arkansas, Colorado, Kansas, part of Missouri, New Mexico, and Texas except coastal ports.
Zone C. Pacific coast.
Zone D: Illinois, Iowa, and Wisconsin.
Zone E: Florida, Georgia, Indiana, Kentucky, Michigan, Ohio, Tennessee, West Virginia, and parts of New York and Pennsylvania.
Zone F: Atlantic seaboard States: Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, parts of Pennsylvania, Rhode Island, South Carolina, Vermont, and Virginia.
Zone G: Mexico.

HELIUM

By H. S. Kennedy and C. W. Seibel

SUMMARY OUTLINE

The Bureau of Mines is concerned with the production of a safe lifting-gas for airships. If lighter-than-air craft are to offer the real assurance of safety necessary for their successful use they must depend on a noninflammable gas for their buoyancy. The only gas having the desired requirements of both lightness and noninflammability is helium. Hydrogen gas, which is about 8 percent more buoyant than helium and has been used extensively as the lifting agent for airships, is extremely explosive. The accidental ignition of hydrogen has been responsible for disasters to various airships in the past, the destruction of the *Hindenburg* being the most recent example.

The airships operated by the Army and Navy and the Goodyear Co. are provided with helium, but all foreign-owned aircraft have depended on the highly inflammable hydrogen for their buoyancy. This situation has existed because the United States is the only nation, so far as known, having sufficient reserves of helium to develop a supply for aeronautics. Army and Navy operations are limited to to nonrigid airships at present; in addition, the Army has a project under development for two motorized balloons.

The Government demand for helium was reduced in 1936 because the Army and Navy operated only nonrigid airships during the year. The President, however, approved the leasing of 1,000,000 cubic feet of helium produced at the Amarillo plant to the Goodyear-Zeppelin Corporation, which operates a fleet of five commercial nonrigid airships. The purpose of leasing the Government helium was to foster the development of commercial lighter-than-air craft and to encourage the training of airship pilots.

In 1936 the Bureau of Mines again supplied about 25,000 cubic feet of helium to the United States Public Health Service, which is cooperating with certain hospitals in the medical use of helium. Helium mixed with oxygen is being used widely in the treatment of asthma; also it is reported to have favorable results in alleviating other respiratory diseases. Investigations are being conducted on the use of helium as a substitute for air in the pneumothorax treatment of tuberculosis, on the theory that it will decrease the frequency of the treatments and may have some effect on the tubercle bacillus. The use of helium-oxygen mixtures for the treatment of atelectasis is

also showing favorable results; the defective expansion of the air cells of the lungs of new-born children is corrected by this treatment.

Cliffside gas field.—The Government Cliffside helium reserve of 50,000 acres in Potter County, Tex., comprising a whole gas structure owned in fee, was operated in 1936 to supply helium-bearing natural gas to the Amarillo helium plant. The field produced 294,838,000 cubic feet of natural gas during the fiscal year 1936, which made a cumulative total of 4,398,659,000 cubic feet of natural gas produced from the field from May 16, 1929 to June 30, 1936. The average rock pressure of the field indicated that the formation pressure in the vicinity of the wells remained constant for the year and represents a decline of only about 2 percent of the total original reserve.

Amarillo helium plant.—The Bureau of Mines helium plant near Amarillo, Tex., operated intermittently during the year. The total production for the fiscal year 1936 was 4,663,355 cubic feet of helium, which represents a considerable reduction over the 1935 production of 10,218,480 cubic feet. Demand for helium was curtailed because the Army and Navy now operate only nonrigid airships. The Amarillo plant has an annual capacity of 24,000,000 cubic feet of helium, and Bureau engineers estimate that the gas could be produced at a net cost to the Government of about $4 per thousand cubic feet if the plant could be operated at its capacity.

From the beginning of operations in May 1929 to June 30, 1936, the plant has produced 73,350,975 cubic feet of helium with an expenditure of $848,805.30 for plant and gas-field operation—an all-time average gross operating cost of $11.57 per thousand cubic feet of helium. The sale of residue gas returned $200,356.02 to the National Treasury during this period, so that the net Government expenditure was $648,449.28, or $8.84 per thousand cubic feet of helium produced.

Government helium production and costs, April 1921 to June 1936

Period	Production [1]	Gross operating cost (expenditures in operation and maintenance) [2]		Return from sale of residue gas	Net operating cost (gross operating cost less return from sale of residue gas) [2]	
		Total	Average per M cubic feet produced		Total	Average per M cubic feet produced
Fort Worth plant: [3]						
Under jurisdiction of Navy Department:	*Cubic feet*					
April to June 1921	260,520	$126,694.05	$486.31			
July to December 1921	1,841,000	320,859.73	174.28			
October 1922 to June 1923 [4]	4,069,940	489,299.70	120,22			
July 1923 to June 1924	8,204,665	636,438.38	77.57			
July 1924 to June 1925	9,418,363	451,084.58	47.89			
	23,794,488	2,024,376 44	85.08			
Under jurisdiction of Bureau of Mines:						
July 1925 to June 1926	9,355,623	318,446.40	34.04			
July 1926 to June 1927	6,330,056	277,384.70	43.82			
July 1927 to June 1928	6,687,834	274,210.54	41.00			
July 1928 to Jan. 10, 1929	2,638,894	121,440.65	46.02			
	25,012,407	991,482.29	39.64			
Amarillo plant: [5]						
Under jurisdiction of Bureau of Mines:						
April to June 1929	844,900	27,833.16	32.94	$2,645.32	$25,187.84	$29.81
July 1929 to June 1930 [6]	9,805,600	140,146.75	14.30	30,445.43	109,701.32	11.19
July 1930 to June 1931	11,362,730	150,190.53	13.22	32,510.24	117,680.29	10.36
July 1931 to June 1932	15,171,680	148,545.26	9.79	40,862.43	107,682.83	7.10
July 1932 to June 1933	14,749,960	151,165.51	10.25	37,661.70	113,503.81	7.70
July 1933 to June 1934	6,534,270	63,528.33	9.72	17,585.94	45,942.39	7.03
July 1934 to June 1935	10,218,480	114,216.62	11.18	26,517.77	87,698.85	8.58
July 1935 to June 1936	4,663,355	53,179.14	11.40	12,127.19	41,051.95	8.80
	73,350,975	848,805.30	11.57	200,356.02	648,449.28	8.84

[1] Production from the Fort Worth plant represents volume of airship gas produced, which had an average helium purity of 94 to 95 percent. Production from the Amarillo plant represents actual helium in the airship gas of better than 98-percent purity produced by that plant. Therefore, the advantage of the Amarillo plant from standpoint of cost is about 5 percent greater than a direct comparison of the figures indicates.

[2] Gross operating costs for the Forth Worth plant represent expenditures in operating and maintaining the plant, including current expenditures for natural gas. The Government did not own the gas field that supplied the Fort Worth plant, so there was no return from sale of residue. Gross operating cost for the Amarillo plant represents expenditure in operating and maintaining both the plant and the Government-owned gas properties. This gross operating cost at Amarillo is a measure of the amount that must be available to the Bureau of Mines for current expenditure. Returns from sale of residue gas must be deposited to credit of miscellaneous receipts of the Treasury and therefore are not available for expenditure by the Bureau. As the net operating cost is computed by subtracting current returns from current expenditures, it is a measure of the net withdrawal of funds from the Treasury for operation and maintenance.

[3] Costs at the Fort Worth plant are based on compilations by the Bureau of Efficiency from records of the Navy Department and the Bureau of Mines. (Report of Bureau of Efficiency in hearing on Armarillo helium plant before the Committee on Mines and Mining, House of Representatives, 71st Cong., 2d sess., p. 210.) The costs do not include depreciation or depletion, and those for period of Navy jurisdiction do not include cost of Washington administration.

[4] Plant closed in 1922 from January to September, inclusive, because of lack of funds.

[5] Compiled from Bureau of Mines records. The costs do not include depreciation or depletion.

[6] Plant shut down entire months of December 1929 and February 1930. Stand-by costs for these 2 months were $19,181.14.

ASPHALT AND RELATED BITUMENS

By A. H. Redfield[1]

SUMMARY OUTLINE

Recovery in the asphalt industry is indicated by production and demand in 1936 which exceeded the records of the previous peak years, 1927 and 1929. To meet an increase of 28 percent in total demand, domestic and foreign, petroleum refineries in the United States enlarged their output of asphalt only 24 percent from 1935 to 1936. Accordingly, stocks of asphalt at the refineries were reduced 15 percent during the year. Imports—relatively insignificant—were more than halved. As domestic requirements constituted 96 percent of the total demand, the decrease of 15 percent in exports had little effect on the national market.

Larger Federal and State allotments of funds to highways supplied the principal impulse to the accelerated demand for manufactured and native asphalts from 1935 to 1936. Increased construction of hard-surfaced roads and streets fostered a 36-percent advance in sales of paving asphalt and a 74-percent advance in sales of natural rock asphalt. Similarly, increased construction of lighter-type highways is indicated by an advance of 44 percent in sales of cut-back asphalts, 31 percent in sales of asphalt emulsions, and 21 percent in sales of road oil. Continued revival in building construction caused an 18-percent increase in sales of roofing asphalt and flux and accelerated sales of waterproofing asphalt and flux, and asphaltic paints and varnishes.

Greater demand for paving and roofing asphalts raised the prices of these products and emulsions, in contrast to the downward trend in prices of other varieties of manufactured asphalt and bituminous rock. Sales values of gilsonite and of paints and varnishes manufactured from petroleum asphalt were lower in 1936 than in 1935. Demand from the electrical industry raised the sales value of asphaltic molding compounds in 1936.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Salient statistics of asphalt and related bitumens in the United States, 1935-36

		1935	1936
SUPPLY			
Native asphalt and related bitumens:			
Produced	short tons	347,392	577,637
Imported (chiefly lake asphalt)	do	53,972	21,598
Petroleum asphalt (excluding road oil):			
Produced at refineries from—			
Domestic petroleum	do	1,801,778	2,327,367
Foreign petroleum	do	1,485,225	1,738,255
		3,287,003	4,065,622
Stocks, Jan. 1	do	339,237	429,739
Total supply	do	4,027,609	5,094,596
DISTRIBUTION			
Native asphalt and related bitumens:			
Indicated domestic demand	short tons	328,168	563,397
Exports (unmanufactured)	do	19,229	14,240
Petroleum asphalt (excluding road oil):			
Indicated domestic demand (including lake asphalt)	do	3,027,648	3,962,257
Exports	do	222,825	190,503
Stocks, Dec. 31	do	429,739	364,199
Total distribution		4,027,609	5,094,596
VALUES			
Native asphalt and related bitumens:			
Sales		$2,148,761	$3,193,995
Imports (chiefly lake asphalt)		544,651	316,144
Exports (unmanufactured)		709,709	528,066
Petroleum asphalt:			
Sales (excluding road oil) from—			
Domestic petroleum		16,141,162	22,355,127
Foreign petroleum		15,213,516	18,789,452
Total sales		31,354,678	41,144,579
Exports		3,370,559	2,835,173

NATIVE ASPHALT AND BITUMENS

Bituminous rock.—Revival of highway construction caused sales of bituminous rock by producers to increase from 314,109 short tons valued at $1,449,406 in 1935 to 547,333 tons valued at $2,420,792 in 1936. Rock-asphalt operators in Kentucky, Alabama, and Ohio sold 109,179 tons valued at $650,927 in 1935 and 178,208 tons valued at $1,054,265 in 1936. Producers in Texas, Oklahoma, and New Mexico sold 185,013 tons valued at $726,801 in 1935 and 333,243 tons valued at $1,245,442 in 1936. Gains were also made in Kansas, Missouri, and California.

Gilsonite and wurtzilite.—Increased demand for paints and varnishes and for electrical fittings brought higher prices for gilsonite. The value of gilsonite sales by producers in northeastern Utah increased 10 percent—from $696,601 in 1935 to $767,066 in 1936. The quantity sold, however, decreased 9 percent—from 33,227 short tons in 1935 to 30,227 tons in 1936, exports dropping rather than domestic sales. Sales of wurtzilite increased from 61 short tons valued at $2,754 in 1935 to 77 tons valued at $6,137 in 1936.

Exports.—Decreased demand from Europe, notably Germany, the United Kingdom, and Italy, caused exports of natural asphalt and bitumen, unmanufactured, to drop from 19,229 short tons valued at $709,709 in 1935 to 14,240 tons valued at $528,066 in 1936. Of the exports, 67 percent went to Europe in 1936 compared with 72 percent in 1935, 13 percent to Canada compared with 8 percent in 1935, 6

percent to South America compared with 12 percent in 1935, and 11 percent to Asia compared with 5 percent in 1935.

MANUFACTURED OR PETROLEUM ASPHALT

Domestic demand for asphalt increased from 3,027,648 short tons in 1935 to 3,962,257 in 1936. Exports of petroleum asphalt decreased from 222,825 tons in 1935 to 190,503 in 1936. In response to the increase of 902,287 tons in total demand, domestic and foreign, refinery production of asphalt increased from 3,287,003 tons in 1935 to 4,065,622 in 1936. At the same time stocks of asphalt at petroleum refineries were reduced 65,540 tons in 1936 compared with an increase of 90,502 tons in 1935. Imports of asphalt and bitumen decreased from 53,972 tons in 1935 to 21,598 in 1936.

Production, receipts, stocks, consumption, transfers and losses, and sales of asphalt (exclusive of road oil) at petroleum refineries in the United States in 1936, by districts

District	Production	Other petroleum products blended	Receipts from other sources	Stocks	
				Dec. 31, 1935	Dec. 31, 1936
	Short tons	Short tons	Short tons	Short tons	Short tons
East coast	1,582,749	78,928	78,033	129,944	111,649
Appalachian	90,969		3,273	16,180	11,480
Indiana-Illinois-Kentucky	738,273	30,198	14,938	87,676	87,814
Oklahoma-Kansas-Missouri	180,889	21,760	326	35,496	25,980
Texas:					
Gulf coast	265,175			9,862	13,855
Rest of State	72,025	2,794	3,279	8,857	6,990
Total, Texas	337,200	2,794	3,279	18,719	20,845
Louisiana-Arkansas:					
Louisiana Gulf coast	241,022	15,316		41,507	36,172
Northern Louisiana and Arkansas	111,627	11,588	5,183	25,687	10,810
Total, Louisiana and Arkansas	352,649	26,904	5,183	67,194	46,982
Rocky Mountain	109,407	13,924	5,538	15,163	12,744
California	476,702	22,276	24,133	59,367	46,705
Grand total, 1936	3,868,838	196,784	134,703	429,739	364,199
Total, 1935	3,115,118	171,885	71,003	339,237	429,739

District	Consumption by companies	Transfers and losses	Sales	
			Quantity	Value
	Short tons	Short tons	Short tons	
East coast	8,690	45,547	1,703,768	$18,152,133
Appalachian	981		97,961	1,337,346
Indiana-Illinois-Kentucky	5,110	467	777,694	7,955,104
Oklahoma-Kansas-Missouri	33	3,689	208,769	1,305,228
Texas:				
Gulf coast	63,233	654	197,295	1,861,788
Rest of State	4,762		75,203	783,958
Total, Texas	67,995	654	272,498	2,645,746
Louisiana-Arkansas:				
Louisiana Gulf coast	3,725		257,948	2,766,784
Northern Louisiana and Arkansas	10	2,750	140,515	1,149,239
Total, Louisiana and Arkansas	3,735	2,750	398,463	3,916,023
Rocky Mountain	3,358	2,110	125,820	1,242,765
California	41,230	4,771	489,772	4,590,234
Grand total, 1936	131,132	59,988	4,074,745	41,144,579
Total, 1935	22,559	102,343	3,142,602	31,354,678

Production.—Of the 1936 production of petroleum asphalt, 43 percent was made from foreign crude oil imported from Venezuela and Mexico compared with 45 percent manufactured from foreign crude in 1935. Runs to stills of foreign petroleum increased 6 percent—from 32,131,000 barrels in 1935 to 33,933,000 barrels in 1936. However, since most of the foreign oil run to stills in 1936 comprised heavy Venezuelan and Mexican crudes, the production of asphalt from foreign oil increased 17 percent—from 1,485,225 short tons in 1935 to 1,738,255 in 1936. Eighty-five percent of the asphalt manufactured

Asphalt and asphaltic material (exclusive of road oil) sold at petroleum refineries in the United States, in 1936, by varieties

[Value f. o. b. refinery]

	From domestic petroleum		From foreign petroleum		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Solid and semisolid products of less than 200 penetration: [1]						
Asphalt for:						
Paving	607,388	$6,115,636	583,317	$6,108,086	1,190,705	$12,223,722
Roofing	386,022	4,093,839	441,007	4,903,623	827,029	8,997,462
Waterproofing	104,126	932,838	65,841	697,374	169,967	1,630,212
Blending with rubber	4,217	44,507	18,920	192,029	23,137	236,536
Briquetting	61,807	666,224	1,378	17,257	63,185	683,481
Mastic and mastic cake	237	2,195	1,018	11,222	1,255	13,417
Pipe coatings	10,956	140,121	2,142	19,812	13,098	159,933
Molding compounds	8,943	109,730	5,116	57,664	14,059	167,394
Miscellaneous uses	75,269	756,524	48,000	455,574	123,269	1,212,098
Total	1,258,965	12,861,614	1,166,739	12,462,641	2,425,704	25,324,255
Semisolid and liquid products of more than 200 penetration: [1]						
Flux for:						
Paving	129,997	661,147	23,934	666,657	153,931	1,327,804
Roofing	184,707	1,720,390	62,541	240,006	247,248	1,960,396
Waterproofing	5,654	53,408	20,298	207,970	25,952	261,378
Cut-back asphalts	584,973	5,762,565	436,317	4,766,724	1,021,290	10,529,289
Emulsified asphalts and fluxes	30,807	337,665	22,238	230,221	53,045	567,886
Paints, enamels, japans, and lacquers	15,137	159,709	9,762	109,875	24,899	269,584
Other liquid products	113,394	798,629	9,282	105,358	122,676	903,987
Total	1,064,669	9,493,513	584,372	6,326,811	1,649,041	15,820,324
Grand total, 1936	2,323,634	22,355,127	1,751,111	18,789,452	4,074,745	41,144,579
Total, 1935	1,709,117	16,141,163	1,433,485	15,213,515	3,142,602	31,354,678

[1] DEFINITIONS

Paving asphalt.—Refined asphalt and asphaltic cement, fluxed and unfluxed, produced for direct use in the construction of sheet asphalt, asphaltic concrete, asphalt macadam, and asphalt block pavements, and also for use as joint filler, in brick, block, and monolithic pavements.

Roofing asphalt.—Asphalt and asphaltic cement used in saturating, coating, and cementing felt or other fabric and in the manufacture of asphalt shingles.

Waterproofing asphalt.—Asphalt and asphaltic cement used to waterproof and dampproof tunnels, foundations of buildings, retaining walls, bridges, culverts, etc., and for constructing built-up roofs.

Briquetting asphalt.—Asphalt and asphaltic cement used to bind coal dust or coke breeze into briquets.

Mastic and mastic cake.—Asphalt and asphaltic cement for laying foot pavements and floors, waterproofing bridges, lining reservoirs and tanks, capable of being poured and smoothed by hand troweling.

Pipe coatings.—Asphalt and asphaltic cement used to protect metal pipes from corrosion.

Molding compounds.—Asphalts used in the preparation of molded composition, such as battery boxes, electrical fittings, push buttons, knobs, handles, etc.

Miscellaneous uses.—Asphalt and asphaltic cement used as dips, and in the manufacture of acid-resisting compounds, putty, saturated building paper, fiber board, and floor coverings, and not included in the preceding definitions.

Flux.—Liquid asphaltic material used in softening native asphalt or solid petroleum asphalt for paving, roofing, waterproofing, and other purposes.

Cut-back asphalts.—Asphalts softened or liquefied by mixing them with petroleum distillates.

Emulsified asphalt and fluxes.—Asphalts and fluxes emulsified with water for cold-patching, road laying and other purposes.

Other liquid products.—Petroleum asphalt, exclusive of fuel oil used for heating purposes, not included in the preceding definitions.

in East coast refineries in 1936 and 62 percent of that manufactured in Gulf coast refineries was made from foreign crude. At the same time, the production of asphalt from domestic crudes increased (especially in the Indiana-Illinois-Kentucky, Oklahoma-Kansas-Missouri, interior Texas, and Rocky Mountain districts) from 1,801,778 short tons in 1935 to 2,327,367 tons in 1936. The total refinery output of asphalt in 1936 included 196,784 tons of other petroleum products blended with the asphalt to produce commercial varieties of the required consistency.

Stocks.—Stocks of asphalt held at petroleum refineries decreased 65,540 tons—from 429,739 tons on December 31, 1935, to 364,199 on December 31, 1936. Only the Gulf coast refineries of Texas furnished an exception to the general reduction in inventories.

Sales.—Sales of asphalt by petroleum refineries increased in quantity from 3,142,602 short tons in 1935 to 4,074,745 tons in 1936 and in value from $31,354,678 in 1935 to $41,144,579 in 1936. The average sales value per short ton increased from $9.98 in 1935 to $10.10 in 1936.

The increase in sales was general but was greatest in the East Coast district, where 1,300,924 tons of asphalt were sold in 1935 and 1,703,768 in 1936. There were also notable increases in asphalt sales in the Indiana-Illinois-Kentucky district (646,006 tons in 1935 and 777,694 in 1936), in the Oklahoma-Kansas-Missouri district (93,102 tons in 1935 and 208,769 in 1936), in the Gulf Coast districts of Texas and Louisiana (315,015 tons in 1935 and 455,243 in 1936), and in the Rocky Mountain district (75,715 tons in 1935 and 125,820 in 1936). Of the major asphalt-producing districts California had the lowest proportional increase—from 443,181 tons in 1935 to 489,772 in 1936.

Nearly three-fifths of the petroleum asphalt sold in the United States in 1936 was used to surface streets and highways. An indicated increase of 10 percent in the total funds, Federal, State, and municipal, available for highway construction made possible an increase of 39 percent in the tonnage of asphalt sold primarily for paving. The gain was greater in the semisolid and liquid asphalts, which are used primarily for the construction of the lighter types of highway; nevertheless, sales of paving asphalt, which are used for the higher types of consumption, were 36 percent greater in 1936 than in 1935.

All available statistical information points to an increase in rural highway construction in 1936. The State highways built, as reported by the Association of State Highway Officials, increased from 25,853 miles in 1935 to 32,635 in 1936. The length of highways completed under the supervision of the Bureau of Public Roads, through its use of Public Works, Emergency Relief, and Federal-aid funds, increased from 13,017 miles in 1935 to 18,390 in 1936. At the end of 1936, 8,003 miles were under construction and 2,635 had been approved for construction compared with 7,766 miles under construction and 5,903 approved for construction at the end of 1935. According to the Bureau of Public Roads, employment on Federal and State highways, both for construction and maintenance, increased from 301,660 man-months in 1935 to 335,991 in 1936.

In 1936, as in 1935, Federal funds financed by far the greater part of the highway mileage constructed. Federal and State funds available for street and highway construction were 10 percent greater in 1936 than in 1935. The total value of highway contracts awarded and

force-account work undertaken, financed by Federal funds, increased from $353,967,106 in 1935 to $367,574,865 in 1936, and contract awards financed by State funds, as reported to the Bureau of Labor Statistics, increased even more in proportion—from $52,782,494 in 1935 to $80,508,252 in 1936.

According to the Bureau of Labor Statistics the value of contracts for street paving awarded and force-account work begun in cities with populations exceeding 150,000 totaled $12,847,082 in 1935 and $12,803,065 in 1936. This decrease of 0.3 percent in money expended for street paving in the larger cities represented a decline of approximately 6 percent in the yardage of pavement laid, when allowance is made for the increase, according to the cost index of the Engineering News Record, of about 6 percent in construction costs from 1935 to 1936.

Bituminous types constituted 24 percent of the total highway mileage reported by the Association of State Highway Officials for 1936 compared with 20 percent in 1935. Of the mileage in 1936 48 percent comprised light types of construction while 18.1 percent comprised mere grading and draining operations (17.5 percent in 1935). Asphaltic types of construction accounted for 70 percent of the total hard-surfaced mileage in 1935 and 71 percent in 1936.

Increased construction of high-type, hard-surfaced roads is indicated by an increase in sales of paving asphalt of less than 200 penetration (from 877,466 tons in 1935 to 1,190,705 in 1936). The increase was general except for the Indiana-Illinois-Kentucky district, with a reduction from 96,338 tons in 1935 to 90,263 in 1936. The greatest gain was in sales by East coast refineries (from 433,454 tons in 1935 to 611,478 in 1936). Gulf coast refineries of Texas and Louisiana increased their sales of paving asphalt from 118,059 tons in 1935 to 173,716 in 1936. Refineries of northern Louisiana and Arkansas continued to increase their sales of paving asphalt (from 37,232 tons in 1935 to 51,695 in 1936). Rocky Mountain refineries, which sold only 3,742 tons of paving asphalt in 1935, sold 30,539 tons in 1936. There were smaller increases in the Oklahoma-Kansas-Missouri district and in interior Texas. California showed the smallest proportional increase in sales of paving asphalt (from 137,340 tons in 1935 to 146,165 in 1936).

Sales of paving asphalt made from foreign petroleum increased from 457,695 tons in 1935 to 583,317 in 1936, and sales of paving asphalt made from domestic crude increased from 419,771 tons in 1935 to 607,388 in 1936.

There was a parallel increase in sales of paving flux (from 113,066 tons in 1935 to 153,931 in 1936). The principal gains occurred in the east coast district, in coastal Texas and Louisiana, and in California.

An even greater proportional increase in the construction of the lighter types of highway is indicated by a gain in the sales of semisolid and liquid asphalts used primarily for paving. Sales of cut-back asphalts increased from 707,953 tons in 1935 to 1,021,290 in 1936 and of emulsified asphalts by petroleum refineries from 39,861 tons in 1935 to 53,045 in 1936.

Sales of cut-back asphalts gained most in the east coast district, where refineries sold 307,095 tons in 1935 and 384,333 in 1936; next ranked the Oklahoma-Kansas-Missouri district, where refineries increased their sales of cut-backs from 69,417 tons in 1935 to 139,004 in 1936 and in third place stood the Illinois-Indiana-Kentucky district, where refineries sold 117,608 tons in 1935 and 166,268 in 1936. In

Louisiana and Arkansas sales of cut-back asphalts increased from 75,970 tons in 1935 to 121,958 in 1936. The highest proportional gain took place in California, where 33,094 tons of cut-backs were sold in 1935 and 82,457 in 1936.

Petroleum refineries sold 39,861 short tons (9,390,633 gallons) of asphalts and fluxes emulsified with water valued at $359,650 in 1935 and 53,045 tons (12,496,579 gallons) valued at $567,886 in 1936. In addition, 33,248,105 gallons valued at $3,434,877 were sold in 1935 by industrial companies that purchased asphalt from petroleum refineries and 43,464,787 gallons valued at $3,976,345 in 1936. Accordingly, total sales of emulsified asphalts and fluxes increased in quantity from 42,638,738 gallons in 1935 to 55,961,366 in 1936 and in value from $3,794,527 in 1935 to $4,544,231 in 1936.

As a result of the pronounced increase in paving demand only 26 percent of the asphalt sold in 1936 was used in the manufacture of prepared roofing compared with 29 percent in 1935. Nevertheless, continued revival in building construction caused sales of roofing asphalt and roofing flux to increase 18 percent in quantity (from 911,216 short tons in 1935 to 1,074,277 in 1936) and 23 percent in value (from $8,913,628 in 1935 to $10,957,858 in 1936). This gain generally paralled the increase, reported by the Bureau of the Census, of 24 percent in sales of prepared roofing (from 26,050,151 squares in 1935 to 32,218,862 in 1936) and the increase, reported in the Survey of Current Business, of 21 percent in shipments of dry roofing felt (from 221,123 short tons in 1935 to 267,742 in 1936). Sales of roofing asphalt and flux increased principally in the east coast district (from 353,349 tons in 1935 to 459,337 tons in 1936) and in the Indiana-Illinois-Kentucky district (from 280,314 tons in 1935 to 329,054 tons in 1936). Smaller gains in the Oklahoma-Kansas-Missouri district, in inland Texas, in the Gulf coast of Louisiana and Texas, and the Rocky Mountain district offset a major decline in California (from 106,265 tons in 1935 to 68,139 in 1936) and smaller decreases in the Appalachian district and in northern Louisiana and Arkansas.

Building construction was reponsible for the demand for 6 percent of the asphalt sold in 1935 and 5 percent of that sold in 1936 in the form of waterproofing asphalt and flux; mastic and mastic flux; and paints, enamels, japans, and lacquers. Such sales increased 11 percent—from 200,203 tons in 1935 to 222,073 in 1936. They did not keep pace, however, with the increase of 62 percent in floor space of building contracts awarded, as compiled for 37 States by the F. W. Dodge Corporation. Contracts for residential building increased 64 percent, while contracts for nonresidential structures increased 60 percent.

Although the production of coal briquets increased only 31 percent (from 860,707 short tons in 1935 to 1,124,973 in 1936) sales of briquetting asphalt increased 54 percent (from 40,945 tons in 1935 to 63,185 in 1936). Plants using asphalt as a binder accounted for a larger proportion of the total output in 1936 than in 1935.

Despite the increase of only 17 percent in domestic consumption of rubber, crude and reclaimed, reported in the Survey of Current Business, sales of asphalt for blending with rubber increased 53 percent (from 15,131 tons in 1935 to 23,137 in 1936).

Notwithstanding continued improvement in the demand for electrical equipment, sales of asphaltic molding compounds decreased from 14,670 tons in 1935 to 14,059 in 1936.

The greater demand for paving and roofing asphalts and fluxes raised the prices of these products in contrast to the downward trend in prices of other varieties. The average sales value of paving asphalt at the refinery increased from $10.03 per short ton in 1935 to $10.27 in 1936; of roofing asphalt, from $10.70 in 1935 to $10.88 in 1936; and of roofing flux, from $7.71 in 1935 to $7.93 in 1936. Similarly, the average value of emulsified asphalt sold by petroleum refineries rose from $9.02 in 1935 to $10.71 in 1936. Revival in the electrical industry raised the sales value of asphaltic molding compounds from $10.97 per ton in 1935 to $11.91 in 1936. On the other hand, the average sales value of waterproofing asphalt declined from $10.87 per short ton in 1935 to $9.59 in 1936; of cut-back asphalts, from $10.46 in 1935 to $10.31 in 1936; and of paints, enamels, japans,

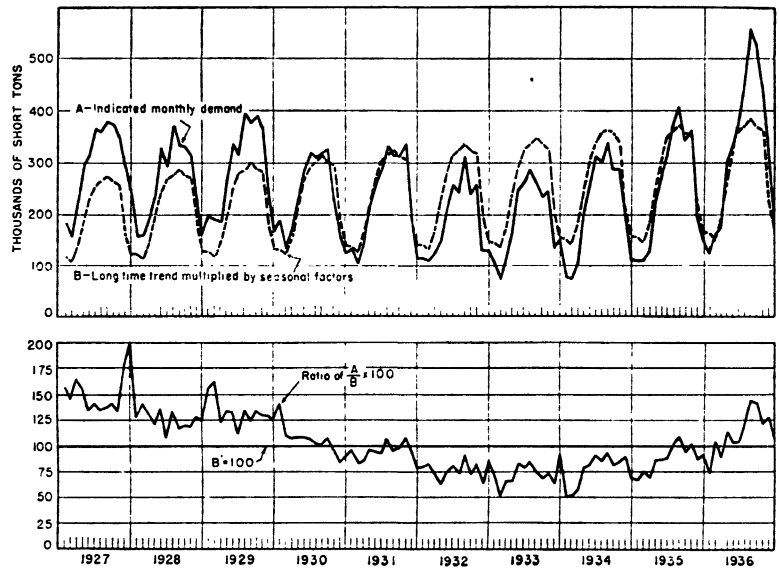


FIGURE 81.—Relation of indicated monthly demand for asphalt, 1927-36, to long-time trend, 1908-36, multiplied by seasonal factors. The long-time trend is expressed by the formula, log Y=1.121409+0.906962 log X, in which Y equals the average monthly demand for petroleum and lake asphalt during each year and X equals the number of years, beginning with 1907 as zero. The coefficient of correlation for this formula is 0.954. The seasonal factors were calculated for 1927-36 by the method of link relatives.

and lacquers from $11.86 in 1935 to $10.83 in 1936. The greatest decline was in the sales value of pipe coatings—from $16.41 in 1935 to $12.21 in 1936.

DOMESTIC DEMAND

The indicated domestic demand for petroleum asphalt (including small quantities of imported lake asphalt and grahamite) was 31 percent greater in 1936 than in 1935, increasing from 214,116 short tons a month in 1934 and 252,304 in 1935 to 330,188 in 1936.

In terms of the long-time trend (revised to include 1936) the indicated demand exceeded by 18 percent the expected demand for 1936, whereas it was 7 percent below the expected demand for 1935; that is, if the national demand had continued the average rate of growth it manifested from 1908 to 1936, it would have averaged 253,943 tons a month in 1933, 262,786 tons a month in 1934, 271,602 tons a month

in 1935, and 280,381 tons a month in 1936. Using these averages as a standard of comparison, the indicated demand of 252,304 tons a month in 1935 was 93 percent of the expected demand (271,602 tons), and the indicated demand of 330,188 tons a month in 1936 was 118 percent of the expected demand (280,381 tons). (See fig. 81.)

However, the demand for asphalt is seasonal to a marked degree, reaching its maximum in August and its minimum in February. Normally, 65 percent of the indicated consumption of asphalt occurs in the 6 months from May 1 to October 31; from 1934 to 1936, 69 percent of the annual total was apparently consumed in these months. Consequently, to furnish an adequate standard of comparison the monthly trend values are multiplied by a "seasonal factor" for each month.

The demand for asphalt was lowest in the first quarter of 1936, averaging 90 percent of the revised long-time trend multiplied by seasonal factors compared with 71 percent in the first 3 months of 1935. In the second quarter of 1936 it rose to an average of 107 percent of the expected demand for these months compared with 90 percent during the second quarter of 1935. From July to September 1936 the indicated demand was highest, averaging 137 percent of the expected demand compared with 103 percent in the same months of 1935. In the last quarter of 1936 the indicated demand declined relatively, averaging 122 percent of the expected demand compared with 97 percent in the last 3 months of 1935.

Relation of indicated asphalt demand to basic trend multiplied by seasonal factors, 1935–36

Month	1935			1936		
	Trend, multiplied by seasonal factors	Indicated monthly demand	Relation of indicated monthly demand to trend	Trend, multiplied by seasonal factors	Indicated monthly demand	Relation of indicated monthly demand to trend
	Short tons	*Short tons*	*Percent*	*Short tons*	*Short tons*	*Percent*
January	158,941	109,484	68.9	164,079	121,817	74.2
February	145,877	111,281	76.3	150,593	159,623	106.0
March	187,052	129,315	69.1	193,098	173,928	90.1
April	256,447	227,962	88.9	264,736	302,521	114.3
May	315,493	280,178	88.8	325,691	337,026	103.5
June	351,263	318,315	90.6	362,617	378,257	104.3
July	361,421	374,109	103.5	373,103	459,838	123.2
August	375,544	411,849	109.7	387,683	561,510	144.8
September	361,041	345,421	95.7	372,710	530,624	142.4
October	353,544	365,543	103.4	364,972	446,795	122.4
November	226,217	199,966	88.4	233,529	299,822	128.4
December	166,383	154,225	92.7	171,761	190,496	110.9
	3,259,223	3,027,648	92.9	3,364,572	3,962,257	117.8

DISTRIBUTION BY RAIL

The tonnage of asphalt (natural, byproduct, or petroleum) terminated by class I railroads in the United States increased from 3,067,182 short tons in 1935 to 4,180,450 in 1936, according to freight-commodity statistics compiled by the Interstate Commerce Commission. The gains were general but were greatest in the area lying between the Ohio and Potomac Rivers and the Great Lakes, in the Southeastern States, and in the Pacific-Rocky Mountain district.

Fifty-seven percent of the asphalt (petroleum, lake, and natural rock) terminated in the continental United States by land carriers in 1936 was delivered to consumers in the Northeastern district lying north of the Potomac and Ohio Rivers and east of the Mississippi and Illinois Rivers. Railroads and motor trucks terminated 2,046,889 short tons of asphalt in this district in 1935 and 2,578,648 in 1936. In the Southeastern district, lying south of the Potomac and Ohio Rivers and east of the Mississippi and Pearl Rivers, land deliveries of asphalt increased from 374,300 tons in 1935 to 596,977 in 1936. In the Southwestern district, lying west of the Mississippi and Pearl Rivers and south of St. Louis, Kansas City, and Amarillo, asphalt deliveries by rail and truck increased from 189,699 tons in 1935 to 265,660 in 1936. In the North Central district, lying between the Great Lakes and the Rocky Mountain front, 424,998 tons of asphalt were delivered in 1935 and 508,640 tons in 1936. In the Pacific-Rocky Mountain district, lying west of Great Falls, Cheyenne, Denver, Albuquerque, and El Paso, the tonnage of asphalt terminated by land carriers increased from 319,855 tons in 1935 to 575,716 in 1936.

Supply and distribution of asphalt (petroleum, lake, and natural rock), exclusive of road oil in continental United States in 1936, by districts, in short tons

	Northeastern district	Southeastern district	Southwestern district	North Central district	Pacific-Rocky Mountain district
Produced within district	2,267,705	506,469	1,144,977		724,108
Imported	16,272	2,296	2,904		110
Received by rail from:					
Northeastern district		45,000	4,000	345,517	
Southeastern district	382,995				
Southwestern district	122,000	401,864		131,000	40,000
Pacific-Rocky Mountain district	[1] 74,445		9,401	32,400	
Net receipts by water	123,743	17,000			
Withdrawn from stocks	16,853	8,871	24,735		15,081
	3,004,013	981,500	1,186,017	508,917	779,299
Shipped by rail:					
Within district	2,486,961	571,072	205,249	508,640	527,179
To Northeastern district		382,995	122,000		[1] 74,445
To Southeastern district	45,000		401,864		
To Southwestern district	4,000				9,401
To North Central district	345,517		131,000		32,400
To Pacific-Rocky Mountain district			40,000		
Shipped by motor truck	91,687	25,905	60,411		48,537
Net shipments by water			131,500		9,243
Exported	30,848	1,528	93,993	277	78,094
	3,004,013	981,500	1,186,017	508,917	779,299

[1] Shipped chiefly by water.

FOREIGN TRADE

Imports.—Imports of asphalt and bitumen into the United States decreased from 53,972 short tons valued at $544,651 in 1935 to 21,598 tons valued at $316,144 in 1936. The principal decrease was in receipts of lake asphalt from Trinidad—from 38,824 tons valued at $403,117 in 1935 to 14,642 tons valued at $173,679 in 1936. On the other hand, imports of grahamite from Cuba increased from 6,011 tons valued at $99,667 in 1935 to 6,692 tons valued at $118,991, in 1936.

Atlantic coast ports (chiefly New York, Baltimore, and Norfolk) received 16,203 tons valued at $234,765 in 1936 compared with 41,163 tons valued at $382,858 in 1935 and Gulf coast ports (chiefly Mobile, New Orleans, and Galveston) 5,201 tons valued at $78,084 in 1936 compared with 12,659 tons valued at $158,437 in 1935.

Exports.—Exports of petroleum asphalt continued the downward trend which has been evident since 1928, decreasing from 222,825 short tons valued at $3,370,559 in 1935 to 190,503 tons valued at $2,835,173 in 1936. Increases in exports to South America and to southern and eastern Africa did not offset the drop in sales to northern and western Europe and to North American countries. Larger shipments to Netherland India did not counteract the general slump in exports of asphalt to eastern Asia and to Australia and New Zealand. Greater refining activity in Europe, Canada, and Japan and increased exports of asphalt from Mexico reduced the foreign market for asphalt produced in American refineries.

Petroleum asphalt exported from the United States, 1934–36, by countries

Country	1934		1935		1936	
	Short tons	Value	Short tons	Value	Short tons	Value
North America:						
Canada	2,937	$63,113	4,203	$78,707	3,695	$75,171
Other North America	6,927	109,509	8,105	118,709	5,803	86,475
	9,864	172,622	12,308	197,416	9,498	161,646
South America:						
Argentina	2,120	40,720	421	7,846	226	5,246
Brazil	3,713	64,970	3,321	55,785	5,823	76,686
Other South America	2,599	42,159	2,070	34,594	2,136	30,256
	8,432	147,858	5,812	98,225	8,185	112,188
Europe:						
Belgium	4,183	66,578	3,918	58,666	2,697	37,246
Denmark	1,781	30,356	144	4,590	26	1,157
France	14,815	217,956	6,228	100,580	4,556	71,014
Germany	5,031	89,599	1,954	44,311	682	17,078
Italy	28,765	417,273	27,365	424,815	27,830	395,017
Netherlands	7,136	120,091	1,272	20,779	1,049	14,872
Spain	4,819	65,981	4,773	60,842	337	6,309
United Kingdom	22,107	461,624	25,578	516,325	20,829	399,820
Other Europe	4,511	80,291	4,021	65,211	4,227	70,041
	93,148	1,549,749	75,253	1,296,119	62,233	1,012,554
Asia:						
Ceylon	6,788	76,210	2,992	44,094	2,295	27,528
China	3,816	59,695	8,059	112,811	7,348	100,724
East Indies:						
British:						
India	7,984	123,082	17,068	231,513	13,966	192,920
Malaya	7,566	114,403	9,185	139,250	8,791	134,276
Netherland	24,012	284,354	12,700	170,109	17,903	238,506
French Indochina	3,612	48,306	7,757	103,323	8,458	107,588
Hong Kong	3,276	51,967	2,443	35,197	2,014	30,644
Japan	4,003	61,705	4,880	77,932	3,858	51,591
Philippine Islands	9,989	108,736	13,846	143,789	10,695	122,226
Other Asia	142	2,646	343	6,350	861	13,549
	71,188	931,104	79,273	1,064,368	76,189	1,019,552
Africa:						
Algeria and Tunisia [1]	42	659			59	1,060
Mozambique	5,526	85,518	2,708	42,657	8,758	151,712
Union of South Africa	7,541	118,555	8,264	128,746	12,892	198,950
Other Africa	1,436	28,114	8,540	130,400	833	13,987
	14,545	232,846	19,512	301,803	22,542	365,709
Oceania:						
Australia	23,065	298,678	24,385	329,180	6,536	92,608
New Zealand	3,505	48,438	6,229	82,201	4,582	59,018
Other British	159	2,148	53	1,247	738	11,898
	26,729	349,264	30,667	412,628	11,856	163,524
	223,906	3,383,443	222,825	3,370,559	190,503	2,835,173

[1] Tunisia only in 1936.

Of the petroleum asphalt exported from the United States, 87,955 short tons passed through Gulf coast ports in 1936 compared with 90,214 tons in 1935, 75,229 tons through Pacific coast ports in 1936 compared with 100,503 tons in 1935, and 24,871 tons through Atlantic coast ports in 1936 compared with 29,063 tons in 1935.

ROAD OIL

Increased construction of light types of highway resulted in an increase of 21 percent in sales of road oil by petroleum refineries in the United States—from 6,798,932 barrels in 1935 to 8,256,694 in 1936. However, if sales of road oil are considered with sales of cut-back asphalts, paving flux, and emulsified asphalts, there was a larger proportionate increase (30 percent) in total sales of liquid and semiliquid asphalts for highway construction—from 12,316,545 barrels in 1935 to 16,052,833 in 1936.

Sales of road oil increased principally in California, northern Louisiana and Arkansas, the Gulf coast district of Texas, and the Oklahoma-Kansas-Missouri district. In California an increase of 831,308 barrels in sales of road oil was paralleled by an increase of 271,497 barrels in sales of cut-back asphalts. In the Oklahoma-Kansas-Missouri district an increase of 173,725 barrels in sales of road oil was exceeded by the increase of 382,729 barrels in sales of cut-back asphalts. In northern Louisiana and Arkansas an increase of 121,265 barrels in sales of road oil was accompanied by an increase of 40,766 barrels in sales of cut-back asphalts. No cut-backs were made in the Texas Gulf coast district, however, where sales of road oil increased 276,692 barrels from 1935 to 1936. On the other hand, a decrease of 49,223 barrels in sales of road oil by refineries of the Louisiana Gulf coast district was more than offset by an increase of 212,168 barrels in sales of cut-back asphalts, a decrease of 5,814 barrels in road-oil sales in the Indiana-Illinois-Kentucky district by an increase of 267,630 barrels in sales of cut-back asphalts, and a decrease of 6,406 barrels in road-oil sales in the Rocky Mountain district by an increase of 93,682 barrels in sales in cut-back asphalts.

Road oil sold by petroleum refineries in the United States, 1935–36, by districts

District	1935		1936	
	Barrels	Value	Barrels	Value
East coast	1,001,845	$1,614,179	1,094,687	$1,748,326
Appalachian	34,035	64,437	54,617	111,601
Indiana-Illinois-Kentucky	1,957,569	2,439,100	1,951,755	2,565,451
Oklahoma-Kansas-Missouri	597,450	547,789	771,175	954,080
Texas:				
Gulf coast	99,969	153,069	376,661	623,274
Rest of State	22,772	35,775	25,563	33,075
Total Texas	122,741	188,844	402,224	656,349
Louisiana-Arkansas:				
Louisiana Gulf coast	68,203	103,334	18,980	33,953
Northern Louisiana and Arkansas	384,769	357,745	506,034	508,698
Total Louisiana and Arkansas	452,972	461,079	525,014	542,651
Rocky Mountain	644,485	1,032,907	638,079	989,246
California	1,987,835	2,194,621	2,819,143	2,858,904
Grand total	6,798,932	8,542,956	8,256,694	10,427,208

Of the road oil sold in the United States in 1936, only 617,079 barrels valued at $991,400 were made from foreign petroleum imported from Venezuela and Mexico. Of the road oil made from foreign crude, 89 percent was sold by refineries of the Atlantic seaboard in 1935 and 79 percent in 1936; the remainder was made in Gulf coast refineries of Louisiana and Texas.

Petroleum refineries in the United States reported the production of 7,397,868 barrels of road oil in 1936 compared with 6,030,491 barrels in 1935. The refinery output of road oil was augmented in 1936 by 1,096,583 barrels of other petroleum products, chiefly fuel oil, transferred to road-oil stocks compared with 1,399,656 barrels similarly transferred in 1935. Stocks of road oil and of transferred oils held at refineries increased from 739,605 barrels (revised figure) on December 31, 1935, to 851,035 on December 31, 1936. Consumption of road oil at refineries in their own operations, transfers, losses, and adjustments was 126,327 barrels in 1936 compared with 555,457 (revised figure) in 1935.

While the national average sales value of road oil at the refineries remained unchanged at $1.26 in both 1935 and 1936, considerable local variations occurred from 1935 to 1936. In general, prices rose in the central United States—in the Indiana-Illinois-Kentucky district from $1.25 per barrel in 1935 to $1.31 in 1936, in the Oklahoma-Kansas-Missouri district from $0.92 in 1935 to $1.24 in 1936, in northern Louisiana and Arkansas from $0.93 in 1935 to $1.01 in 1936, and in the Gulf coast of Texas from $1.53 in 1935 to $1.65 in 1936. On the East coast sales values remained practically unchanged, averaging $1.61 per barrel in 1935 and $1.60 in 1936. On the other hand, the average sales value in the Rocky Mountain district fell from $1.60 in 1935 to $1.55 in 1936 and in California from $1.10 in 1935 to $1.01 in 1936.

CEMENT[1]

By Oliver Bowles and B. W. Bagley

SUMMARY OUTLINE

Production of portland cement in the United States in 1936 increased to 112,396,000 barrels and shipments to 112,566,000 barrels valued at $170,431,000, according to figures compiled from monthly reports of the Bureau of Mines. These quantities, which are above the 100-million barrel mark for the first time since 1931, represent a gain of 46 percent in production and 50 percent in shipments over 1935 but are still 36 percent less than those of the peak year, 1928, when 176,298,846 barrels were produced and 175,838,332 barrels shipped. In 1936 the industry operated at 42.7 percent of capacity, compared with only 28.6 percent in 1935, a low of 23.5 percent in 1933 and a high of 76.1 percent in 1927.

Extensive highway building, large Federal Public Works projects, and renewed activity in private construction all contributed to the increase in cement shipments. The degree of recovery in many other industries has been greater than that in cement manufacture, as is indicated by the fact that the Federal Reserve Board annual index for cement production in 1936 was 75, compared with 105 for all industries. Compared with the index of 55 for the construction industries, however, the showing of the cement industry is definitely encouraging, particularly in view of the consistent improvement month by month over the corresponding figures for 1935.

Prices were unchanged in 1936. The composite quotation of the Bureau of Labor Statistics remained at $1.667 a barrel, and the average sales realization calculated from shipments reported to the Bureau of Mines was $1.51 a barrel, as in 1935.

Shipments in 1936 include approximately 3,015,000 barrels of high-early-strength portland cement with an estimated mill value of $5,769,000, compared with 2,109,000 barrels valued at $4,032,000 in 1935.

The quantity of natural, masonry, and puzzolan cements produced gained 72 percent and the quantity sold, 65 percent. The value of sales of these varieties increased about 57 percent.

[1] Data for 1936 are preliminary; detailed statistics with final revisions will be released later.

The accompanying table of salient statistics presents the outstanding features of the cement industry in 1936 compared with previous years.

Salient statistics of the cement industry in the United States, 1925–36

	1925–29 (average)	1930–34 (average)	1935	1936 [1]
Domestic production:				
Portland .... barrels	169, 268, 093	100, 917, 640	76, 741, 570	112, 396, 000
Masonry, natural, and puzzolan .... do	2, 075, 594	925, 778	1, 006, 064	1, 725, 810
Total production .... do	171, 343, 687	101, 843, 418	77, 747, 634	114, 121, 810
Active plants:				
Portland .... number	150	157	150	149
Masonry, natural, and puzzolan .... do	11	13	13	13
Domestic shipments:				
Portland .... barrels	167, 410, 737	101, 447, 418	75, 232, 917	112, 566, 000
Value	$272, 694, 192	$130, 853, 277	$113, 372, 182	$170, 431, 000
Masonry, natural, and puzzolan .... barrels	2, 062, 935	929, 866	1, 011, 411	1, 663, 942
Value	$2, 822, 707	$1, 263, 661	$1, 437, 542	$2, 249, 866
Total shipments .... barrels	169, 473, 672	102, 377, 284	76, 244, 328	114, 229, 942
Value	$275, 516, 899	$132, 116, 938	$114, 809, 724	$172, 680, 866
Imports .... barrels	2, 605, 046	533, 147	619, 403	1, 658, 902
Exports .... do	904, 125	561, 298	416, 099	334, 673
Apparent consumption .... do	171, 174, 593	102, 349, 133	76, 447, 632	115, 554, 171
Stocks at mills:				
Portland:				
Finished cement .... do	21, 598, 876	22, 327, 609	22, 949, 247	22, 842, 000
Clinker [2] .... do	7, 582, 000	6, 745, 000	5, 226, 000	5, 605, 000
Masonry, natural, and puzzolan .... do	152, 961	187, 046	[3] 171, 775	233, 643

[1] Subject to revision. [2] Estimated. [3] Revised figures.

PORTLAND CEMENT

PRODUCTION, SHIPMENTS, AND STOCKS

The following tables show production, shipments, and stocks of portland cement by States and districts in 1934 and 1935 and summaries of monthly estimates of portland cement produced, shipped, and in stock at mills by districts in 1935 and 1936.

In the first table the term "active plant" is applied to a mill or group of mills situated at one place and operated by one company. If a company has establishments at different places its mill or group of mills at each place is counted as a plant. The districts are groups of States related geographically and commercially.

The tables giving data by months have been compiled from monthly reports of operators. Although the totals may differ slightly from those based on annual reports of producers, they reflect accurately the seasonal fluctuations in the industry.

Portland cement produced, shipped, and in stock in the United States, 1934–35, by States and districts

State	Active plants		Production			Shipments							Stock at mills (Dec. 31)		
			Barrels		Increase or decrease 1935 (percent)	1934		1935		Average factory value per barrel		Increase or decrease in quantity, 1935 (percent)	Barrels		Increase or decrease 1935 (percent)
	1934	1935	1934	1935		Barrels	Value	Barrels	Value	1934	1935		1934 [1]	1935	
Alabama	6	5	2,208,279	2,493,291	+13	2,181,513	$3,017,329	2,483,616	$3,521,418	$1.38	$1.42	+14	485,559	495,234	+2
California	10	10	8,721,854	7,974,201	−9	8,395,037	12,449,389	8,137,880	11,174,973	1.48	1.37	−3	1,434,171	1,270,492	−11
Illinois	4	4	4,124,805	3,367,512	−18	3,908,107	5,498,568	3,276,970	4,500,897	1.41	1.37	−16	805,804	896,346	+11
Iowa	5	5	3,180,546	3,519,558	+11	3,340,049	5,094,922	3,203,301	5,072,098	1.53	1.58	−4	1,445,613	1,761,870	+22
Kansas	6	6	2,497,911	2,337,444	−6	2,425,867	3,734,493	2,487,888	3,778,104	1.54	1.52	+3	995,963	845,519	−15
Michigan	10	10	4,103,902	4,578,966	+12	3,945,375	5,920,211	4,325,134	5,971,720	1.50	1.38	+10	1,797,062	2,050,894	+14
Missouri	5	5	4,033,859	3,392,140	−16	3,779,125	5,449,606	3,291,332	4,940,713	1.44	1.50	−13	803,639	904,447	+12
New York	10	10	4,760,609	4,285,458	−10	4,730,257	7,503,270	4,240,461	6,612,399	1.59	1.56	−10	1,580,585	1,625,582	+3
Ohio	10	9	4,045,854	3,876,172	−4	3,674,384	5,565,525	3,698,309	5,306,449	1.51	1.43	+.7	1,558,930	1,736,793	+11
Pennsylvania	25	26	15,323,116	15,502,086	+1	15,435,648	23,138,676	15,034,441	21,917,366	1.50	1.46	−3	4,544,585	5,012,230	+10
Tennessee	6	6	2,481,379	2,702,622	+9	2,305,578	3,645,659	2,733,726	4,203,078	1.58	1.54	+19	590,903	559,799	−5
Texas	9	9	3,537,734	3,786,716	+7	3,418,781	5,995,677	3,715,300	6,422,807	1.75	1.73	+9	671,360	742,776	+11
Other States [2]	44	45	18,727,917	18,925,404	+1	18,361,558	29,907,756	18,604,559	29,950,100	1.63	1.61	+1	4,726,420	5,047,265	+7
	150	150	77,747,765	76,741,570	−1	75,901,279	116,921,084	75,232,917	113,372,182	1.54	1.51	−1	21,440,594	22,949,247	+7

[1] Revised figures.
[2] Arkansas, Colorado, Florida, Georgia, Idaho, Indiana, Kentucky, Louisiana, Maine, Maryland, Minnesota, Montana, Nebraska, New Jersey, Oklahoma, Oregon, South Dakota, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.

Portland cement produced, shipped, and in stock in the United States, 1934–35, by States and districts—Continued

District	Active plants		Production			Shipments							Stock at mills (Dec. 31)		
			Barrels		Increase or decrease 1935 (percent)	1934		1935		Average factory value per barrel		Increase or decrease in quantity, 1935 (percent)	Barrels		Increase or decrease 1935 (percent)
	1934	1935	1934	1935		Barrels	Value	Barrels	Value	1934	1935		1934	1935	
Eastern Pennsylvania, New Jersey, and Maryland	22	23	14,917,633	14,581,492	−2	14,939,237	$22,395,697	14,190,795	$20,777,257	$1.50	$1.46	−5	3,579,843	3,970,540	+11
New York and Maine	11	11	5,015,615	4,582,936	−9	5,010,637	7,998,640	4,505,376	7,072,216	1.60	1.57	−10	1,676,779	1,754,339	+5
Ohio, western Pennsylvania, and West Virginia	19	18	7,355,563	7,300,481	−1	6,963,534	10,547,449	6,947,416	10,046,397	1.51	1.45	−.2	3,030,326	3,383,391	+12
Michigan	10	10	4,103,902	4,578,966	+12	3,945,375	5,920,214	4,325,134	5,971,720	1.50	1.38	+10	1,797,062	2,050,894	+14
Wisconsin, Illinois, Indiana, and Kentucky	11	11	9,079,458	8,204,274	−10	8,899,493	12,872,160	8,220,831	11,882,230	1.45	1.45	−8	2,043,275	2,026,718	−1
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	18	17	7,560,020	7,656,504	+1	7,257,757	11,173,407	7,675,206	11,709,374	1.54	1.53	+6	1,735,094	1,716,392	−1
Eastern Missouri, Iowa, Minnesota, and South Dakota	11	11	7,786,482	7,876,617	+1	7,826,458	11,646,388	7,412,709	11,431,062	1.49	1.54	−5	2,440,078	2,873,986	+18
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	12	12	5,837,914	5,966,245	+2	5,549,945	8,789,590	6,059,932	9,350,994	1.58	1.54	+9	1,992,523	1,898,836	−5
Texas	9	9	3,537,734	3,786,716	+7	3,418,781	5,995,677	3,715,300	6,422,807	1.75	1.73	+9	671,360	742,776	+11
Colorado, Montana, Utah, Wyoming, and Idaho	8	9	2,181,218	2,336,204	+7	2,101,796	3,788,362	2,173,926	3,974,692	1.80	1.83	+3	449,903	612,181	+36
California	10	10	8,721,854	7,974,201	−9	8,395,037	12,449,389	8,137,880	11,174,973	1.48	1.37	−3	1,434,171	1,270,492	−11
Oregon and Washington	9	9	1,650,372	1,896,934	+15	1,593,229	3,344,111	1,838,412	3,558,460	2.10	1.94	+15	590,180	648,702	+10
	150	150	77,747,765	76,741,570	−1	75,901,279	116,921,084	75,232,917	113,372,182	1.54	1.51	−1	21,440,594	22,949,247	+7

Summary of monthly estimates of portland cement produced, shipped, and in stock at mills in the United States in 1935, by districts, in thousands of barrels

District	January	February	March	April	May	June	July	August	September	October	November	December
PRODUCTION												
Eastern Pennsylvania, New Jersey, and Maryland	547	535	883	1,415	1,695	1,681	1,468	1,192	1,138	1,417	1,402	791
New York and Maine		3	141	444	664	587	577	544	592	543	283	193
Ohio, western Pennsylvania, and West Virginia	54	61	248	542	783	996	917	817	903	895	685	403
Michigan	116	118	112	322	495	551	595	561	536	481	478	266
Wisconsin, Illinois, Indiana, and Kentucky	458	422	487	600	974	1,092	656	522	797	825	848	535
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	345	439	589	701	664	953	740	645	667	623	606	679
Eastern Missouri, Iowa, Minnesota, and South Dakota	467	372	393	368	848	907	905	930	724	612	676	677
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	295	255	267	430	671	725	687	695	400	516	508	552
Texas	294	221	278	347	355	275	470	261	259	283	327	435
Colorado, Montana, Utah, Wyoming, and Idaho	113	77	152	125	269	256	277	201	181	280	243	202
California	471	461	634	565	661	563	643	669	729	788	854	936
Oregon and Washington	42	89	115	277	143	139	86	198	247	247	183	134
United States, 1935	3,202	3,053	4,299	6,136	8,222	8,725	8,021	7,235	7,173	7,510	7,093	5,803
1934	3,779	4,168	5,257	6,544	8,554	8,813	8,144	7,842	7,680	6,675	5,779	4,447
SHIPMENTS												
Eastern Pennsylvania, New Jersey, and Maryland	471	432	919	1,309	1,601	1,469	1,347	1,486	1,302	1,577	1,125	764
New York and Maine	77	72	218	386	571	581	519	512	476	548	342	203
Ohio, Western Pennsylvania, and West Virginia	221	226	394	514	649	807	801	770	795	860	587	317
Michigan	75	81	177	288	386	495	535	572	617	676	321	173
Wisconsin, Illinois, Indiana, and Kentucky	181	231	458	539	764	878	1,052	1,091	1,043	1,073	566	349
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	461	458	594	671	733	796	724	778	639	665	619	527
Eastern Missouri, Iowa, Minnesota, and South Dakota	179	227	416	540	717	840	900	866	928	1,073	452	308
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	259	293	535	634	555	523	619	577	593	646	421	411
Texas	240	229	327	331	340	313	387	354	257	314	313	318
Colorado, Montana, Utah, Wyoming, and Idaho	128	105	116	161	170	182	183	231	305	289	174	142
California	482	467	555	634	738	569	589	693	663	932	917	899
Oregon and Washington	72	130	169	191	204	179	157	175	181	141	139	103
United States, 1935	2,846	2,951	4,878	6,198	7,428	7,632	7,813	8,105	7,799	8,794	5,976	4,514
1934	3,778	2,952	4,618	6,492	8,784	8,541	7,898	8,249	7,388	8,439	5,674	3,104

Summary of monthly estimates of portland cement produced, shipped, and in stock at mills in the United States in 1935, by districts, in thousands of barrels—Continued

District	January	February	March	April	May	June	July	August	September	October	November	December
STOCKS (END OF MONTH)												
Eastern Pennsylvania, New Jersey, and Maryland	3,659	3,766	3,729	3,835	3,930	4,142	4,263	3,969	3,805	3,646	3,923	3,971
New York and Maine	1,611	1,542	1,465	1,522	1,615	1,621	1,677	1,712	1,828	1,823	1,764	1,754
Ohio, western Pennsylvania, and West Virginia	2,860	2,703	2,528	2,556	2,690	2,882	2,997	3,045	3,154	3,189	3,281	[1] 3,383
Michigan	1,869	1,905	1,839	1,873	1,982	2,033	2,092	2,080	1,994	1,799	1,956	2,051
Wisconsin, Illinois, Indiana, and Kentucky	2,331	2,522	2,551	2,612	2,821	3,035	2,639	2,071	1,824	1,576	1,859	2,027
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	1,619	1,600	1,596	1,627	1,558	1,715	1,731	1,593	1,619	1,578	1,565	1,716
Eastern Missouri, Iowa, Minnesota, and South Dakota	2,728	2,873	2,851	2,679	2,810	2,877	2,882	2,945	2,742	2,281	2,505	[1] 2,874
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	2,009	1,971	1,703	1,499	1,601	1,803	1,871	1,989	1,797	1,665	1,752	1,899
Texas	725	717	666	682	688	651	734	641	642	611	625	743
Colorado, Montana, Utah, Wyoming, and Idaho	412	384	420	377	476	550	644	613	489	482	551	612
California	1,402	1,396	1,476	1,406	1,330	1,324	1,378	1,354	1,420	1,276	1,213	[1] 1,270
Oregon and Washington	560	520	465	551	490	450	379	403	469	575	619	649
United States, 1935	21,785	21,899	21,289	21,219	21,991	23,083	23,287	22,415	21,783	20,501	21,613	[1] 22,949
1934	19,547	20,762	21,422	21,557	21,301	21,600	21,852	21,424	21,734	19,972	20,078	[1] 21,466

[1] Revised figures.

Summary of monthly estimates of clinker (unground portland cement) produced and in stock at mills in the United States in 1935, by districts, in thousands of barrels

District	January	February	March	April	May	June	July	August	September	October	November	December
PRODUCTION												
Eastern Pennsylvania, New Jersey, and Maryland	581	584	1,053	1,442	1,641	1,618	1,559	1,161	1,024	1,288	1,324	737
New York and Maine	0	0	75	447	677	679	657	583	525	465	275	200
Ohio, western Pennsylvania, and West Virginia	55	28	240	512	882	997	927	829	968	721	626	367
Michigan	123	110	137	291	483	560	576	522	510	475	420	257
Wisconsin, Illinois, Indiana, and Kentucky	450	354	512	629	1,006	1,089	689	521	729	770	791	534
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	358	431	495	552	727	908	757	740	651	628	565	483
Eastern Missouri, Iowa, Minnesota, and South Dakota	532	398	352	401	882	966	869	856	656	585	658	683
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	320	295	239	394	667	757	744	704	371	522	524	550
Texas	262	250	280	352	375	299	322	216	271	274	340	516
Colorado, Montana, Utah, Wyoming, and Idaho	73	80	160	158	241	308	269	219	208	266	242	199
California	560	520	645	596	640	588	565	594	632	698	791	890
Oregon and Washington	57	55	98	119	236	202	167	163	148	268	194	126
United States, 1935	3,371	3,106	4,286	5,893	8,457	9,061	8,101	7,108	6,693	6,960	6,750	5,542
1934	3,981	4,174	5,615	6,802	8,224	8,888	8,276	7,548	7,300	6,726	5,853	4,370
STOCKS (END OF MONTH)												
Eastern Pennsylvania, New Jersey, and Maryland	690	741	922	950	914	864	965	948	840	719	658	637
New York and Maine	340	337	272	280	299	394	484	523	461	388	381	391
Ohio, western Pennsylvania, and West Virginia	643	607	599	571	673	686	691	706	771	610	549	514
Michigan	778	771	796	771	763	792	788	755	755	771	722	502
Wisconsin, Illinois, Indiana, and Kentucky	353	285	312	340	371	370	403	402	334	278	221	220
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	649	627	547	402	468	518	538	637	624	631	593	402
Eastern Missouri, Iowa, Minnesota, and South Dakota	510	537	500	535	579	638	609	543	484	467	457	444
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	367	404	376	341	331	361	427	437	391	397	416	413
Texas	184	218	219	229	244	284	139	94	107	101	118	204
Colorado, Montana, Utah, Wyoming, and Idaho	22	25	33	62	35	88	80	98	125	111	111	109
California	1,441	1,489	1,475	1,560	1,454	1,413	1,340	1,291	1,204	1,119	1,069	1,081
Oregon and Washington	341	307	292	111	234	300	385	342	272	299	312	309
United States, 1935	6,318	6,348	6,343	6,122	6,365	6,741	6,849	6,779	6,368	5,891	5,607	5,226
1934	5,919	5,936	6,318	6,565	6,304	6,424	6,588	6,332	5,975	6,055	6,213	6,166

Summary of monthly estimates of portland cement produced, shipped, and in stock in the United States in 1936, by districts, in thousands of barrels

District	January	February	March	April	May	June	July	August	September	October	November	December
PRODUCTION												
Eastern Pennsylvania, New Jersey, and Maryland	388	465	941	1,821	2,347	2,021	2,178	2,463	2,192	2,401	2,054	1,769
New York and Maine	0	0	109	531	524	801	763	805	820	810	542	413
Ohio, western Pennsylvania, and West Virginia	144	147	191	665	1,041	1,261	1,237	1,373	1,305	1,277	1,210	770
Michigan	171	151	155	298	792	728	852	1,001	1,030	1,053	918	617
Wisconsin, Illinois, Indiana, and Kentucky	492	384	555	696	1,141	1,230	1,240	1,458	1,465	1,243	1,040	812
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	391	354	610	790	963	989	938	1,057	1,011	1,082	1,002	891
Eastern Missouri, Iowa, Minnesota, and South Dakota	354	298	388	643	1,050	1,204	1,206	1,185	1,215	1,133	981	857
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	266	294	474	709	798	835	826	891	851	887	737	655
Texas	260	375	535	655	458	444	449	581	595	543	444	501
Colorado, Montana, Utah, Wyoming, and Idaho	94	73	86	289	348	332	319	261	290	341	331	246
California	909	823	1,037	1,199	1,263	1,138	1,061	1,082	1,098	1,272	1,274	1,235
Oregon and Washington	181	111	230	316	379	394	434	442	475	428	444	205
United States, 1936	3,650	3,475	5,311	8,612	11,104	11,377	11,503	12,599	12,347	12,470	10,977	8,971
1935	3,202	3,053	4,299	6,136	8,222	8,725	8,021	7,235	7,173	7,510	7,093	5,803
SHIPMENTS												
Eastern Pennsylvania, New Jersey, and Maryland	505	376	1,141	1,759	2,168	2,352	2,342	2,370	2,318	2,430	1,733	1,120
New York and Maine	118	82	263	407	625	756	745	754	801	756	463	291
Ohio, western Pennsylvania, and West Virginia	283	163	557	800	1,138	1,324	1,175	1,349	1,308	1,335	838	525
Michigan	148	99	304	481	740	1,056	1,081	1,090	1,238	1,023	518	289
Wisconsin, Illinois, Indiana, and Kentucky	263	205	672	914	1,245	1,434	1,345	1,535	1,418	1,458	889	511
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	448	419	787	790	930	885	923	987	971	1,088	975	715
Eastern Missouri, Iowa, Minnesota, and South Dakota	205	151	511	758	1,264	1,501	1,230	1,377	1,298	1,289	578	305
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	324	263	735	812	814	841	780	897	836	986	736	490
Texas	395	397	557	583	458	518	496	509	450	531	492	467
Colorado, Montana, Utah, Wyoming, and Idaho	128	133	236	280	331	335	303	300	315	327	213	159
California	942	801	1,119	1,192	1,149	1,105	1,007	1,067	1,183	1,366	1,204	1,102
Oregon and Washington	158	88	304	406	378	414	396	389	483	500	303	272
United States, 1936	3,917	3,177	7,186	9,182	11,240	12,521	11,823	12,624	12,619	13,089	8,942	6,246
1935	2,846	2,951	4,878	6,198	7,428	7,632	7,813	8,105	7,799	8,794	5,976	4,514

STOCKS (END OF MONTH)												
Eastern Pennsylvania, New Jersey, and Maryland	3,854	3,943	3,741	3,800	3,979	3,642	3,478	3,575	3,550	3,522	3,847	4,496
New York and Maine	1,641	1,560	1,405	1,530	1,429	1,475	1,494	1,544	1,564	1,619	1,698	1,820
Ohio, western Pennsylvania, and West Virginia	3,228	3,211	2,844	2,708	2,611	2,548	2,610	2,634	2,631	2,573	2,942	3,187
Michigan	2,094	2,147	2,001	1,819	1,871	1,543	1,319	1,226	1,017	1,046	1,447	1,774
Wisconsin, Illinois, Indiana, and Kentucky	2,275	2,453	2,336	2,118	2,013	1,809	1,703	1,626	1,673	1,458	1,610	1,911
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	1,658	1,593	1,416	1,415	1,448	1,551	1,567	1,637	1,674	1,670	1,697	1,873
Eastern Missouri, Iowa, Minnesota, and South Dakota	3,023	3,156	3,033	2,919	2,705	2,409	2,385	2,193	2,110	1,954	2,357	2,910
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	1,843	1,874	1,614	1,531	1,515	1,509	1,555	1,530	1,556	1,458	1,458	1,623
Texas	608	586	565	635	635	561	515	587	731	743	696	730
Colorado, Montana, Utah, Wyoming, and Idaho	577	517	366	375	392	389	412	364	348	362	480	567
California	1,216	1,239	1,187	1,194	1,309	1,341	1,394	1,409	1,324	1,186	1,256	1,389
Oregon and Washington	669	692	618	527	524	504	543	595	560	488	629	562
United States, 1936	22,686	22,971	21,126	20,571	20,431	19,281	18,975	18,920	18,738	18,079	20,117	22,842
1935	21,785	21,899	21,289	21,219	21,991	23,083	23,287	22,415	21,783	20,501	21,613	22,949

Summary of monthly estimates of clinker (unground portland cement) produced and in stock at mills in the United States in 1936, by districts, in thousands of barrels

District	January	February	March	April	May	June	July	August	September	October	November	December
PRODUCTION												
Eastern Pennsylvania, New Jersey, and Maryland	441	541	1,092	1,786	2,207	1,896	2,109	2,408	2,210	2,308	2,071	1,839
New York and Maine	0	0	107	426	540	772	779	824	713	754	613	425
Ohio, western Pennsylvania, and West Virginia	148	171	258	604	965	1,212	1,293	1,327	1,268	1,306	1,172	861
Michigan	163	154	148	331	657	638	817	953	958	1,031	860	632
Wisconsin, Illinois, Indiana, and Kentucky	523	431	536	682	1,112	1,212	1,328	1,449	1,458	1,288	1,123	958
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	415	414	576	745	953	960	920	1,100	1,074	1,107	1,046	862
Eastern Missouri, Iowa, Minnesota, and South Dakota	429	344	450	634	996	1,197	1,159	1,113	1,150	1,134	1,020	863
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	319	311	460	650	823	784	858	868	824	885	735	687
Texas	223	318	493	703	556	451	377	597	599	533	477	536
Colorado, Montana, Utah, Wyoming, and Idaho	63	78	78	256	351	338	297	296	321	342	323	224
California	794	874	936	1,085	1,281	1,214	1,272	1,100	1,074	1,248	1,275	1,233
Oregon and Washington	172	190	203	344	378	470	424	352	447	508	384	256
United States, 1936	3,690	3,826	5,337	8,246	10,819	11,144	11,633	12,387	12,096	12,444	11,099	9,376
1935	3,371	3,105	4,286	5,893	8,457	9,061	8,101	7,108	6,693	6,960	6,750	5,542
STOCKS (END OF MONTH)												
Eastern Pennsylvania, New Jersey, and Maryland	690	772	924	907	783	682	641	604	654	577	611	696
New York and Maine	391	390	390	290	311	289	313	341	248	195	269	284
Ohio, western Pennsylvania, and West Virginia	520	550	617	551	465	418	481	434	398	426	376	465
Michigan	436	439	436	473	359	300	274	241	187	192	157	177
Wisconsin, Illinois, Indiana, and Kentucky	251	299	279	316	287	269	357	348	341	386	469	615
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	430	491	460	418	412	387	372	421	489	520	567	543
Eastern Missouri, Iowa, Minnesota, and South Dakota	524	574	655	644	604	609	571	501	446	458	501	512
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	458	475	455	400	424	368	394	374	354	322	319	351
Texas	167	114	74	129	228	237	168	189	200	195	230	268
Colorado, Montana, Utah, Wyoming, and Idaho	77	82	74	42	46	53	23	58	90	92	85	64
California	968	1,022	903	769	760	828	1,019	1,022	1,008	1,107	1,148	1,129
Oregon and Washington	302	382	358	380	392	472	466	398	423	510	448	501
United States, 1936	5,214	5,590	5,625	5,328	5,071	4,912	5,079	4,931	4,838	4,980	5,180	5,605
1935	6,318	6,348	6,343	6,122	6,365	6,741	6,849	6,779	6,368	5,891	5,607	5,226

Producers' stocks of portland cement reported on hand at the mills were less than 0.5 percent lower at the end of 1936 than at the end of 1935. The quantity of unground clinker on hand was more than 7 percent higher. The following table gives stocks on December 31 and the seasonal fluctuations in stocks from 1932 to 1936.

Producers' stocks of finished portland cement and clinker (unground cement) on hand at mills in the United States on Dec. 31 and monthly range, 1932–36

		Dec. 31 (barrels)	Monthly range			
			Low		High	
			Month	Barrels	Month	Barrels
1932	Cement	20,351,058	October	17,084,000	March	27,545,000
	Clinker	5,995,000	November	5,938,000	April	10,511,000
1933	Cement	19,605,323	October	19,502,000	August	22,078,000
	Clinker	5,717,000	December	5,717,000	April	7,146,000
1934	Cement	[1] 21,440,594	January	19,547,000	July	21,852,000
	Clinker	6,137,000	do	5,919,000	do	6,588,000
1935	Cement	[1] 22,949,247	October	20,501,000	do	23,287,000
	Clinker	5,226,000	December	5,226,000	do	6,849,000
1936	Cement	22,842,000	October	18,119,000	February	22,985,000
	Clinker	5,605,000	September	4,748,000	March	5,628,000

[1] Revised figures.

DOMESTIC CONSUMPTION

Apparent consumption (shipments plus imports minus exports) for a series of years is indicated in the table of salient statistics. The only available gage of consumption by States is the record of shipments into States by manufacturers; it is therefore merely approximate. Cement manufactured and shipped to destinations within a State is of course added to that shipped from other States. Shipments into a State during any one year may not equal the consumption during that year, but over a series of years they give a fair average of consumption. The following table shows shipments into States in 1935 and 1936 and per-capita consumption in each State.

The official figures for exports of cement on page 1161 differ from those reported by manufacturers in the following table, because cement forwarded from mills and destined for foreign countries is reported by shippers as exported, whether or not it leaves the country during the calendar year, whereas the export figures of the Bureau of Foreign and Domestic Commerce record the cement that actually leaves the country during the period specified. Manufacturers report shipments to noncontiguous Territories of the United States as exports, while in official figures they are not so included. The exports recorded by the Bureau of Foreign and Domestic Commerce include all other hydraulic cement exported, whereas the figures supplied by producers relate to portland cement only.

The per-capita consumption indicated in the table falls short of the total apparent consumption by the quantity of imports, which affect certain States near the Canadian border and the seaboard.

Shipments of domestic portland cement from mills into States and per capita, 1935–36, in barrels [1]

State	1935 Total	1935 Per capita [1]	1936 Total	1936 Per capita [1]
Alabama	1,211,715	0.43	1,242,691	0.43
Arizona [2]	311,303	.81	555,865	1.37
Arkansas	657,946	.33	646,273	.32
California	6,775,139	1.20	11,662,381	1.92
Colorado	596,772	.56	1,141,399	1.07
Connecticut [2]	856,733	.50	1,212,934	.70
Delaware [2]	176,621	.69	346,305	1.34
District of Columbia [2]	843,416	1.42	966,426	1.56
Florida	857,600	.53	1,203,093	.73
Georgia	1,166,613	.35	1,605,123	.52
Idaho	220,577	.46	363,084	.75
Illinois	4,936,007	.63	6,980,310	.89
Indiana	2,342,569	.68	3,397,652	.98
Iowa	1,919,158	.76	2,891,920	1.14
Kansas	1,437,290	.78	2,038,346	1.08
Kentucky	1,062,562	.37	1,623,665	.56
Louisiana	1,018,455	.48	1,541,736	.73
Maine	245,285	.29	373,516	.44
Maryland	995,827	.60	1,395,124	.83
Massachusetts [2]	1,605,664	.37	1,904,626	.43
Michigan	3,324,864	.71	5,745,871	1.20
Minnesota	1,741,114	.66	2,843,967	1.08
Mississippi [2]	516,461	.26	955,086	.48
Missouri	2,122,776	.54	3,263,834	.82
Montana	684,556	1.29	1,455,984	2.74
Nebraska	1,340,989	.98	1,238,060	.91
Nevada [2]	536,617	5.42	202,676	2.03
New Hampshire [2]	248,321	.49	321,109	.63
New Jersey	2,323,926	.54	3,601,520	.83
New Mexico [2]	300,774	.75	535,270	1.27
New York	7,933,134	.62	10,911,774	.84
North Carolina [2]	831,515	.24	1,205,041	.35
North Dakota [2]	261,314	.37	316,834	.45
Ohio	3,436,105	.51	5,429,465	.81
Oklahoma	1,447,358	.58	2,357,050	.93
Oregon	881,737	.87	817,024	.80
Pennsylvania	4,148,220	.41	6,450,285	.64
Rhode Island [2]	335,915	.49	485,740	.71
South Carolina [2]	364,918	.18	600,962	.32
South Dakota	418,237	.62	398,940	.58
Tennessee	1,777,857	.61	2,046,731	.71
Texas	3,638,007	.60	5,462,433	.89
Utah	329,295	.64	514,454	1.00
Vermont [2]	193,156	.51	237,212	.62
Virginia	1,249,582	.47	1,466,997	.55
Washington	1,289,986	.79	3,758,349	2.29
West Virginia	1,090,101	.60	2,059,766	1.13
Wisconsin	2,110,439	.73	2,849,099	.98
Wyoming	182,441	.79	244,249	1.05
Unspecified	23,944		785,286	
	74,320,911	.58	111,653,540	.87
Exports reported by manufacturers but not included above [3]	912,006		912,460	
Total shipped from cement plants	75,232,917		112,566,000	

[1] Per-capita figures based on latest available estimates of population made by the Bureau of the Census.
[2] Non-cement-producing State.
[3] Includes shipments to Alaska, Hawaii, and Puerto Rico.

The following tables of monthly shipments from portland-cement mills into States in 1935 and 1936 are based on monthly reports of producers. The totals may vary slightly from figures based on annual reports, but they reflect with fair accuracy the seasonal fluctuations.

Portland cement shipped from mills into States in 1935, by months, in barrels [1]

Shipped to—	January	February	March	April	May	June	July	August	September	October	November	December
Alabama	85,084	65,390	67,729	96,949	125,624	138,049	105,145	132,834	100,679	73,468	122,120	99,265
Alaska	132	1,588	1,385	1,292	3,606	2,911	3,199	2,292	857	334	132	405
Arizona	17,885	16,491	17,528	22,051	25,304	29,807	22,218	25,040	24,949	34,896	38,758	38,394
Arkansas	34,062	42,333	52,457	49,810	45,982	30,346	42,263	50,882	56,781	53,578	48,212	30,174
California	339,386	360,366	476,831	544,178	625,651	492,178	521,594	593,886	544,526	771,275	764,226	739,297
Colorado	31,312	30,801	44,198	49,795	46,922	48,748	49,355	46,828	51,827	66,384	65,551	64,966
Connecticut	16,359	17,528	44,031	83,903	85,474	79,855	84,991	103,114	91,619	114,010	73,453	39,492
Delaware	7,425	7,005	15,766	23,872	16,101	18,886	11,516	20,864	14,238	14,106	12,842	8,520
District of Columbia	35,783	36,507	68,517	81,020	86,975	66,721	82,679	82,749	70,140	94,483	77,676	49,049
Florida	59,973	54,051	65,735	61,651	72,599	77,243	73,284	66,627	61,908	86,305	84,531	90,171
Georgia	44,636	46,181	83,098	101,377	133,220	97,310	81,920	127,639	141,258	123,618	100,839	85,247
Hawaii	30,129	34,756	31,588	20,496	18,015	12,585	9,978	14,871	16,595	16,302	12,005	25,975
Idaho	5,028	5,343	13,644	22,159	19,887	20,828	19,795	23,118	29,341	31,943	18,519	11,920
Illinois	133,855	159,240	304,977	352,243	414,793	460,779	675,717	701,896	627,998	613,827	304,021	183,527
Indiana	42,793	49,847	165,272	112,689	184,260	270,703	320,488	315,188	308,737	333,169	155,181	81,564
Iowa	27,054	33,454	105,062	156,608	221,903	258,873	255,219	198,781	240,838	315,799	62,821	42,284
Kansas	60,540	67,982	128,846	161,810	126,450	145,962	194,735	124,419	116,845	120,303	94,244	96,312
Kentucky	35,012	33,817	65,020	70,274	84,807	92,233	86,536	99,151	155,170	179,911	98,015	52,552
Louisiana	48,233	49,374	59,995	58,818	95,508	77,777	96,395	113,190	89,471	124,880	117,840	98,116
Maine	2,781	2,682	5,478	20,740	26,798	30,631	30,759	32,836	30,586	36,156	16,472	8,724
Maryland	48,618	33,884	74,697	90,865	123,296	102,149	91,580	105,431	83,589	104,978	80,063	44,280
Massachusetts	39,098	35,667	96,228	162,892	195,075	157,475	165,878	177,197	156,658	188,878	118,469	79,530
Michigan	55,021	60,452	125,537	213,323	325,652	388,582	390,785	432,487	472,668	515,745	261,662	138,704
Minnesota	18,886	29,915	76,326	117,261	189,755	224,024	179,841	193,029	229,383	333,981	76,120	50,311
Mississippi	35,029	27,488	35,453	51,224	49,027	57,885	45,768	39,909	42,774	55,515	48,710	27,847
Missouri	71,721	77,486	147,071	154,777	139,741	185,560	241,883	287,220	259,108	232,514	178,879	146,143
Montana	27,077	16,396	42,471	58,133	86,222	59,625	63,009	72,714	72,324	85,178	54,710	46,663
Nebraska	13,186	25,557	64,916	120,758	115,588	120,153	123,302	163,256	269,681	227,999	57,533	38,898
Nevada	146,814	72,592	24,408	52,504	74,407	23,351	14,192	38,414	28,982	23,076	25,101	21,840
New Hampshire	5,964	5,917	14,295	23,726	30,588	26,211	18,979	26,396	25,316	29,201	19,325	11,134
New Jersey	64,354	60,036	145,437	212,855	249,411	250,449	231,219	239,406	209,997	254,939	183,792	140,009
New Mexico	26,954	18,293	25,998	22,101	20,974	22,590	26,049	25,433	24,471	28,559	29,947	29,930
New York	200,557	176,911	434,962	648,373	874,362	866,247	836,461	879,610	816,484	956,807	655,845	423,555
North Carolina	40,442	44,070	69,516	81,696	85,776	93,280	77,277	72,023	64,466	77,251	70,668	51,867
North Dakota	2,500	5,132	10,075	27,564	37,007	45,148	41,869	31,736	29,770	25,558	3,837	3,371
Ohio	110,874	109,373	219,921	291,780	361,372	423,901	361,795	352,216	359,644	397,927	290,985	157,649
Oklahoma	80,070	84,613	131,675	154,220	121,880	109,697	141,858	130,934	118,468	110,530	115,403	146,778
Oregon	46,266	87,156	82,295	93,008	91,156	77,596	84,400	81,937	74,899	68,245	53,832	40,899
Pennsylvania	140,209	127,574	242,064	370,860	499,612	544,986	451,792	423,903	388,182	433,880	294,383	149,871
Puerto Rico	10,225	14,456	16,656	16,325	15,275	17,975	18,175	39,717	6,475	3,191	5,625	14,418
Rhode Island	5,551	4,779	20,534	82,427	47,797	68,831	41,243	25,491	23,988	30,253	16,731	11,330
South Carolina	26,273	80,173	29,992	28,490	30,160	26,397	32,195	27,215	31,582	37,561	38,211	26,101
South Dakota	4,828	10,950	24,259	32,117	59,207	60,275	66,814	39,966	41,431	58,829	10,758	9,549

[1] Includes estimated distribution from 1 plant for January to March and for May and June.

Portland cement shipped from mills into States in 1935, by months, in barrels—Continued

Shipped to—	January	February	March	April	May	June	July	August	September	October	November	December
Tennessee	142,481	151,904	170,556	171,928	108,450	170,175	185,174	173,145	117,942	122,431	134,434	127,901
Texas	233,622	248,022	357,298	336,631	332,437	307,021	366,594	342,533	239,817	290,001	286,435	300,053
Utah	10,146	14,633	17,843	23,641	27,384	32,876	32,165	38,629	42,323	44,442	27,011	18,801
Vermont	2,096	3,638	6,295	15,114	23,016	18,347	18,373	26,081	29,085	32,186	12,882	4,455
Virginia	53,143	50,523	90,579	105,008	137,335	140,039	133,147	129,842	118,857	121,863	94,816	64,911
Washington	28,998	50,006	88,104	102,226	118,215	107,164	84,189	111,019	145,873	153,584	163,611	136,784
West Virginia	28,038	40,328	45,384	70,578	104,581	113,551	126,186	118,552	148,504	128,918	100,683	67,817
Wisconsin	25,411	33,063	73,405	156,593	224,122	281,966	263,241	260,619	286,277	275,426	122,979	61,932
Wyoming	3,809	5,154	12,273	14,865	13,731	19,278	19,146	34,136	17,865	33,846	12,670	8,037
Unspecified	8,364	35,097	....	9,188	11,846	18,347	34,577	38,877	27,875	64,805	23,815	11,432
	2,814,082	2,905,974	4,833,680	6,154,786	7,384,396	7,613,576	7,776,942	8,055,278	7,779,121	8,752,844	5,937,383	4,458,814
Foreign countries	31,918	45,026	44,320	43,214	43,604	18,424	36,058	49,721	19,879	41,156	38,617	55,186
Total shipped from cement plants	2,846,000	2,951,000	4,878,000	6,198,000	7,428,000	7,632,000	7,813,000	8,105,000	7,799,000	8,794,000	5,976,000	4,514,000

Portland cement shipped from mills into States in 1936, by months, in barrels [1]

Shipped to—	January	February	March	April	May	June	July	August	September	October	November	December
Alabama	80,631	65,620	104,793	86,822	124,529	107,323	92,724	101,127	102,527	134,352	131,125	111,118
Alaska	645	332	677	1,955	3,208	3,784	2,706	2,070	3,472	1,010		
Arizona	40,813	62,422	36,632	41,736	43,627	62,979	65,380	38,691	39,439	33,695	37,173	53,278
Arkansas	33,031	23,434	43,894	57,891	60,719	60,861	61,699	64,838	58,521	71,170	62,296	47,916
California	832,904	699,457	1,009,619	1,086,612	1,047,170	991,568	871,896	954,881	988,496	1,130,323	1,060,357	998,191
Colorado	69,178	61,413	101,517	115,492	107,153	84,879	89,665	101,247	109,041	136,816	102,753	62,245
Connecticut	26,754	14,696	58,716	96,709	124,570	126,633	145,374	153,412	158,531	144,366	102,829	60,344
Delaware	6,425	4,428	19,253	41,411	41,452	44,090	44,395	39,507	26,484	36,030	28,931	13,899
District of Columbia	31,700	18,373	64,757	87,035	91,014	92,610	92,483	96,216	104,120	115,011	99,668	73,439
Florida	64,561	63,690	84,850	92,817	105,355	109,709	120,998	110,751	105,151	135,642	110,191	99,378
Georgia	88,744	77,968	128,890	142,828	129,056	133,077	129,071	173,112	162,858	153,310	171,943	114,266
Hawaii	24,297	20,190	24,528	18,833	20,743	22,462	24,348	24,142	47,767	25,393	7,000	
Idaho	7,236	6,986	26,549	37,704	43,024	37,835	31,733	33,738	41,757	47,062	29,382	20,078
Illinois	123,914	96,972	344,791	502,111	747,219	907,061	872,104	881,677	811,715	913,472	507,209	272,665
Indiana	79,133	51,859	227,674	270,262	359,015	461,324	393,690	457,680	392,952	353,434	218,104	132,525
Iowa	23,457	20,074	110,438	210,379	397,545	482,578	390,400	369,001	325,430	394,828	113,032	54,758
Kansas	64,567	50,748	179,906	218,525	215,162	235,411	176,051	205,084	168,587	214,327	190,697	119,281
Kentucky	41,051	32,636	113,509	141,647	158,019	164,958	163,783	180,221	175,850	206,151	159,106	86,734
Louisiana	92,069	90,533	143,700	134,495	165,891	163,289	135,728	133,182	125,994	141,024	117,537	98,294
Maine	7,331	5,828	11,987	23,336	35,596	44,899	48,836	58,596	60,189	40,719	23,649	12,550
Maryland	33,561	19,746	83,779	123,920	126,602	160,301	139,519	143,409	139,093	194,733	153,368	77,093
Massachusetts	51,526	31,828	117,010	150,944	206,485	221,725	223,394	204,388	212,747	225,929	150,023	108,627
Michigan	120,982	86,068	245,447	374,440	535,123	680,234	666,537	807,931	909,548	727,798	387,228	204,535
Minnesota	41,149	32,170	91,497	181,536	336,631	454,371	539,067	354,010	460,881	364,076	123,045	65,531
Mississippi	26,442	28,535	60,420	55,656	48,445	52,394	114,547	147,168	139,323	124,282	94,631	63,243
Missouri	89,246	51,133	245,291	257,785	316,804	332,437	335,271	416,946	353,935	390,611	310,295	164,080
Montana	29,127	40,752	53,062	80,972	171,490	210,100	238,664	185,602	170,198	184,235	73,154	18,628
Nebraska	23,330	9,169	85,536	108,364	112,301	123,553	94,481	177,878	231,711	156,230	56,909	58,598
Nevada	27,355	19,621	20,333	12,123	13,178	27,565	22,776	17,314	16,115	15,421	9,833	8,042
New Hampshire	11,635	8,329	15,035	22,008	33,080	35,612	33,311	32,566	36,957	44,350	32,757	16,039
New Jersey	87,100	64,398	199,215	296,061	385,050	387,116	390,162	373,567	399,459	436,511	341,185	241,762
New Mexico	24,029	33,808	46,342	47,682	53,787	58,142	46,179	51,198	41,119	52,115	40,026	40,543
New York	229,648	170,066	509,106	819,768	1,151,090	1,366,272	1,363,546	1,334,745	1,257,197	1,313,597	845,261	551,478
North Carolina	46,740	42,789	92,122	104,722	122,625	111,704	117,344	122,813	133,040	134,119	118,598	58,425
North Dakota	1,727	1,661	11,066	27,004	39,163	45,667	35,424	37,664	52,912	43,763	12,886	7,897
Ohio	146,151	86,202	297,827	409,523	613,241	665,233	619,204	682,881	624,511	601,681	402,654	280,357
Oklahoma	129,526	118,655	252,237	251,553	216,515	195,704	173,705	171,395	157,889	236,165	248,146	205,560
Oregon	47,247	33,355	80,401	84,158	77,590	72,665	72,919	79,162	78,033	85,408	59,535	46,551
Pennsylvania	104,069	73,477	268,237	431,417	607,440	789,473	795,622	859,619	854,718	827,993	528,067	310,153
Puerto Rico	6,744	5,425	22,405	34,018	6,850	13,244	14,031	29,598	13,430	13,238	9,900	6,175
Rhode Island	8,758	5,577	21,796	44,939	63,520	59,173	54,561	53,731	53,726	62,149	34,739	23,071
South Carolina	28,830	34,044	41,736	42,653	54,090	56,214	58,544	57,416	63,845	60,720	60,987	41,883

[1] Includes estimated distribution from 1 plant for January, March, and June; 2 plants for April and December; 3 for May; 4 for July, September, and November; 5 for October; and 6 for August.

Portland cement shipped from mills into States in 1936, by months, in barrels—Continued

Shipped to—	January	February	March	April	May	June	July	August	September	October	November	December
South Dakota	6,613	2,797	28,884	37,617	58,593	51,004	38,102	43,946	47,503	50,705	20,736	12,440
Tennessee	94,825	97,240	202,842	172,734	240,918	193,031	168,928	186,321	159,822	214,668	164,133	151,269
Texas	379,285	363,627	532,082	547,217	416,100	484,282	465,938	486,096	417,903	506,182	448,069	415,632
Utah	13,257	17,122	45,644	47,670	57,889	63,171	49,733	58,041	53,318	58,194	30,537	19,878
Vermont	3,178	3,457	12,289	21,252	24,991	25,643	25,930	29,014	35,915	32,883	15,437	7,223
Virginia	46,974	35,084	119,274	143,271	169,336	162,912	154,680	154,908	150,398	142,758	122,763	64,639
Washington	131,007	80,397	252,030	346,863	307,661	345,914	338,239	338,030	475,545	558,831	320,131	263,701
West Virginia	75,733	29,810	99,330	167,092	220,162	243,299	180,104	215,620	241,300	263,949	198,881	124,486
Wisconsin	41,043	24,010	91,442	162,521	257,284	321,664	337,143	446,197	470,163	430,944	174,548	92,140
Wyoming	6,958	4,190	14,998	22,707	24,997	24,265	26,474	28,685	30,109	30,404	19,253	11,209
Unspecified	28,000	26,084	48,000	95,710	119,000	105,007	99,366	93,370	91,589	40,495	26,762	11,903
	3,880,236	3,139,285	7,143,395	9,134,500	11,208,098	12,469,148	11,786,359	12,599,802	12,582,836	13,053,272	8,907,479	6,203,750
Foreign countries	36,764	37,715	42,605	47,500	31,902	51,852	36,641	24,198	36,164	35,728	34,521	42,250
Total shipped from cement plants	3,917,000	3,177,000	7,186,000	9,182,000	11,240,000	12,521,000	11,823,000	12,624,000	12,619,000	13,089,000	8,942,000	6,246,000

PRICES

The average selling price of portland cement f. o. b. factories (excluding the price of containers and cash discounts), as reported to the Bureau of Mines, is given in the table of shipments by States and districts during 1934 and 1935 on page 1139. For certain States and districts white portland cement and other specially prepared types are included, thus the average prices are a little higher than if ordinary portland cement only were considered. Prices by States and districts are not yet available for 1936. The average factory price for the entire country in 1936 was $1.51 a barrel, as in 1935. The average selling price f. o. b. factory of high-early-strength portland cement was $1.91 a barrel, as in 1935. The sales value of natural, masonry, and puzzolan cements is given later in this chapter. The following table shows the average factory value of portland cement from 1932 to 1936.

Average factory value per barrel in bulk of portland cement in the United States, 1932–36

1932	$1.01	1935	$1.51
1933	1.33	1936	1.51
1934	1.54		

PLANT CAPACITY

In 1936 the cement industry operated at 42.7 percent of capacity compared with 28.6 percent in 1935. Figures for plant capacity are based on manufacturers' records supplemented by a few estimates. The following table shows the ratio of production to capacity by months during 1935 and 1936.

Ratio (percent) of finished portland cement produced to manufacturing capacity of the United States, 1935–36

Month	Monthly		12 months ended—		Month	Monthly		12 months ended—	
	1935	1936	1935	1936		1935	1936	1935	1936
January	14.1	16.1	28.8	29.0	July	35.3	51.3	27.7	34.0
February	14.9	16.4	28.4	29.2	August	31.8	56.2	27.4	36.1
March	18.9	23.4	28.0	29.6	September	32.6	57.1	27.3	38.1
April	27.9	39.2	27.9	30.5	October	33.1	56.0	27.6	40.0
May	36.1	48.9	27.7	31.6	November	32.2	50.9	28.1	41.5
June	39.6	52.3	27.7	32.7	December	25.6	40.3	28.6	42.7

Plant capacity by commercial districts in 1934 and 1935 is indicated in the following table. Similar data for 1936 are not yet available.

Portland cement-manufacturing capacity of the United States, 1934–35, by commercial districts

District	Estimated capacity (barrels)		Percent of capacity utilized	
	1934	1935	1934	1935
Eastern Pennsylvania, New Jersey, and Maryland	55, 063, 000	56, 262, 000	27.1	25.9
New York and Maine	18, 402, 000	17, 024, 000	27.3	26.9
Ohio, western Pennsylvania, and West Virginia	28, 227, 000	28, 077, 000	26.1	26.0
Michigan	17, 180, 000	17, 080, 000	23.9	26.8
Wisconsin, Illinois, Indiana, and Kentucky	30, 216, 000	29, 816, 000	30.0	27.5
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	25, 588, 000	25, 556, 000	29.5	30.0
Eastern Missouri, Iowa, Minnesota, and South Dakota	23, 267, 000	23, 217, 000	33.5	33.9
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	17, 559, 000	17, 409, 000	33.2	34.3
Texas	10, 925, 000	11, 072, 000	32.4	34.2
Colorado, Montana, Utah, Wyoming, and Idaho	6, 057, 000	6, 217, 000	36.0	37.6
California	22, 830, 000	22, 790, 000	38.2	35.0
Oregon and Washington	7, 395, 000	7, 395, 000	22.3	25.7
	262, 709, 000	261, 915, 000	29.6	29.3

RAW MATERIALS

The raw material used most extensively for cement manufacture in the United States comprises a mixture of high-calcium limestone and clay or shale. Next in importance is cement rock (argillaceous limestone) either alone or with the addition of high-calcium limestone. A mixture of marl and clay was used extensively prior to 1906, but in recent years most of the plants using marl have been abandoned or are supplied with other raw materials. Mixtures of blast-furnace slag and limestone are important raw materials for cement manufacture in several iron-smelting areas. The accompanying table shows trends in the use of the various raw materials from 1908 to 1935.

Production and percent of total output of portland cement in the United States, 1898–1914, 1926, 1929, 1933, and 1935, according to type of material used

Year	Type 1. Cement rock and pure limestone		Type 2. Limestone and and clay or shale		Type 3. Marl and clay		Type 4. Blast-furnace slag and limestone	
	Barrels	Percent	Barrels	Percent	Barrels	Percent	Barrels	Percent
1898	2, 764, 694	74.9	365, 408	9.9	562, 092	15.2		
1899	4, 010, 132	70.9	546, 200	9.7	1, 095, 934	19.4		
1900	5, 960, 739	70.3	1, 034, 041	12.2	1, 454, 797	17.1	32, 443	0.4
1901	8, 503, 500	66.9	2, 042, 209	16.1	2, 001, 200	15.7	164, 316	1.3
1902	10, 953, 178	63.6	3, 738, 303	21.7	2, 220, 453	12.9	318, 710	1.8
1903	12, 493, 694	55.9	6, 333, 403	28.3	3, 052, 946	13.7	462, 930	2.1
1904	15, 173, 391	57.2	7, 526, 323	28.4	3, 332, 873	12.6	473, 294	1.8
1905	18, 454, 902	52.4	11, 172, 389	31.7	3, 884, 178	11.0	1, 735, 343	4.9
1906	23, 896, 951	51.4	16, 532, 212	35.6	3, 958, 201	8.5	2, 076, 000	4.5
1907	25, 859, 095	53.0	17, 190, 697	35.2	3, 606, 598	7.4	2, 129, 000	4.4
1908	20, 678, 693	40.6	23, 047, 707	45.0	2, 811, 212	5.5	4, 535, 300	8.9
1909	24, 274, 047	37.3	32, 219, 365	49.6	2, 711, 219	4.2	5, 786, 800	8.9
1910	26, 520, 911	34.6	39, 720, 320	51.9	3, 307, 220	4.3	7, 001, 500	9.2
1911	26, 812, 129	34.1	40, 665, 332	51.8	3, 314, 176	4.2	7, 737, 000	9.9
1912	24, 712, 780	30.0	44, 607, 776	54.1	2, 467, 368	3.0	10, 650, 172	12.9
1913	29, 333, 490	31.8	47, 831, 863	51.9	3, 734, 778	4.1	11, 197, 000	12.2
1914	24, 907, 047	28.2	50, 168, 813	56.9	4, 038, 310	4.6	9, 116, 000	10.3
1926	44, 090, 657	26.8	[1] 101, 637, 866	61.8	3, 324, 408	2.0	15, 477, 239	9.4
1929	51, 077, 034	29.9	[1] 97, 623, 502	57.2	4, 832, 700	2.9	17, 112, 800	10.0
1933	14, 136, 171	22.3	[1] 43, 638, 023	68.7	1, 402, 744	2.2	4, 297, 251	6.8
1935	23, 811, 687	31.0	[1] 45, 073, 144	58.8	1, 478, 569	1.9	6, 378, 170	8.3

[1] Includes output of 2 plants in 1926 and 3 plants in 1929, 1933, and 1935, using oyster shells and clay.

MANUFACTURING CONDITIONS

Plants.—In 1936 portland cement was manufactured and shipped from 149 plants, compared with 149 plants producing and 150 shipping in 1935. No new plants were built, and at least one old plant—the State cement plant at Chelsea, Mich., previously manned by prison labor—was dismantled. An old cement mill at Hartshorne, Okla., closed for 16 years, was scheduled for removal and rebuilding in 1937 at Houston, Tex., by the newly formed Gulf Portland Cement Co. The Lone Star Cement Corporation plant at Houston, Tex., was altered and enlarged. Control of another Texas plant, the Longhorn plant of the Republic Portland Cement Co. of San Antonio, changed hands as a result of stock purchase by Gus S. Wortham. The Riverside Cement Co., Oro Grande, Calif., resumed operation after several years of idleness. Early in the year the Marquette Cement Manufacturing Co. announced that it intended to transfer part of its plant capacity in northern Illinois to a southern location and was exploring rock deposits north of Vicksburg, Miss., which it had optioned. The Nazareth (Pa.) plant of the Lone Star Cement Corporation was modernized further during the summer. New silos were built for loading lake vessels by the Huron Portland Cement Co., and the Peerless Cement Corporation of Detroit began reconditioning machinery and buildings at its Port Huron, Mich., plant. Universal Atlas undertook rebuilding of its Leeds (Ala.) plant at an estimated cost of $1,500,000. Calaveras Cement Co., San Andreas, Calif., completed various changes incident to producing white portland cement.

Millions of dollars are being spent by the industry on improvements. Universal-Atlas Cement Co. alone is reported to have a program calling for expenditure of $11,000,000, of which $3,000,000 has been released for rehabilitating its plants at Leeds, Ala., and Hudson, N. Y. Details of improvements made by many other companies are summarized in recent articles.[2]

Construction of a cement plant in Puerto Rico, financed by $850,000 of Works Progress Administration funds, was begun in 1936. This is part of the Government plan to provide cheap cement for roads and home building on the island. Concrete buildings are desirable there, as frame structures are easily destroyed by hurricanes. Exports of hydraulic cement to Puerto Rico in 1936 amounted to 266,964 barrels valued at $385,026.

Fuels.—According to monthly reports of producers the following quantities of fuel were consumed at portland-cement plants in the United States in 1936 in the production of 112,396,000 barrels of finished cement: Coal, 4,772,827 short tons; oil, 2,466,142 barrels; and natural gas 36,928,255,000 cubic feet.

The following table shows detailed data on fuels used in 1934 and 1935.

---

[2] Pit and Quarry, Cement Mills Spend Millions for Improvements as Shipments Soar to Highest Level in Five Years: Vol. 29, no. 1, 1936, pp. 63-67.
Nordberg, B., Cement Plants Add Latest Improvements: Rock Products, vol. 39, no. 10, 1936, pp. 60-65.

Portland cement produced in the United States, 1934–35, by kinds of fuel

Fuel	Finished cement produced			Fuel consumed [1]		
	Number of plants	Barrels of 376 pounds	Percent of total	Coal (short tons)	Oil (barrels of 42 gallons)	Natural gas (M cubic feet)
1934						
Coal [2]	101	[3] 51,358,415	66.0	3,277,021		
Oil	11	[3] 6,592,766	8.5		1,472,100	
Natural gas	11	[3] 6,068,031	7.8			9,618,607
Coal and oil [4]	5	13,728,553	17.7	223,465	390,489	17,712,355
Coal and natural gas [5]	12					
Oil and natural gas	3					
Coal, oil, and natural gas	4					
	147	77,747,765	100.0	[6] 3,500,486	1,862,589	27,330,962
1935						
Coal [2]	103	[3] 50,942,245	66.4	3,260,111		
Oil	10	[3] 5,664,380	7.4		1,187,962	
Natural gas	13	[3] 6,760,672	8.8			10,957,214
Coal and oil	4	13,374,273	17.4	255,867	193,501	15,794,539
Coal and natural gas [5]	14					
Oil and natural gas	3					
Coal, oil, and natural gas	2					
	149	76,741,570	100.0	[7] 3,515,978	1,381,463	26,751,753

[1] Figures compiled from monthly estimates of producers.
[2] In addition to the coal shown for this group 2 plants in 1934 reported the use of petroleum coke with coal. The production figures for this group include the output of 1 plant which used coke-oven gas alone. In 1935,1 plant reported the use of petroleum coke with coal and 1 plant the use of coke-oven gas with coal.
[3] Average consumption of fuel per barrel of cement produced was as follows: 1934—coal, 129.0 pounds; oil, 0.2233 barrel; natural gas, 1,585 cubic feet. 1935—coal, 128.7 pounds; oil, 0.2097 barrel; natural gas, 1,621 cubic feet.
[4] In addition to the coal and oil included for this group, 1 plant reported the use of petroleum coke with coal and oil.
[5] In addition to the coal and natural gas included for this group 2 plants in 1934 reported the use of petroleum coke with coal and natural gas and 1 plant the use of oil and petroleum coke with coal and natural gas; in 1935, 3 plants reported the use of petroleum coke with coal and natural gas.
[6] Includes 42,645 short tons of anthracite and 3,457,841 short tons of bituminous coal.
Includes 59,994 short tons of anthracite and 3,455,994 short tons of bituminous coal.

Natural gas is an important fuel for portland-cement manufacture in certain States. The following table shows the break-down in its use by States as far as permissible for 1934 and 1935.

Natural gas used at portland-cement plants in the United States, 1934–35, by States, in thousands of cubic feet [1]

State	1934	1935
Kansas	4,667,426	4,300,829
Texas	4,513,105	5,258,614
Other States [2]	18,150,431	17,192,310
	27,330,962	26,751,753

[1] Compiled from monthly estimates of producers.
[2] 1934: Arkansas, California, Colorado, Iowa, Missouri, Nebraska, Oklahoma, and South Dakota; 1935: Same States as in 1934, with the addition of Alabama and Louisiana.

Electric power.—The accompanying table shows the electric energy produced at cement plants and that purchased from power companies during 1934 and 1935. Such figures were first compiled in 1930, when 52.5 percent of the power was generated at the plants and 47.5 percent was purchased. The corresponding percentages for 1935, 52.4 and 47.6, show that conditions vary little from those in 1930.

Electrical energy used at portland-cement-producing plants, 1934–35, by processes, in kilowatt-hours

Process	Electrical energy used						Finished cement produced	Average electrical energy used per barrel of cement produced
	Generated at portland-cement plants		Purchased		Total			
	Active plants	Kilowatt-hours	Active plants	Kilowatt-hours	Kilowatt-hours	Percent	Barrels	Kilowatt-hours
1934								
Wet	35	382,006,670	67	475,439,748	857,446,418	50.0	38,299,376	22.4
Dry	37	559,040,924	48	299,703,177	858,744,101	50.0	39,448,389	21.8
	72	941,047,594	115	775,142,925	1,716,190,519	100.0	77,747,765	22.1
Percent of total electrical energy used	-------	54.8	-------	45.2	100.0	------	----------	----------
1935								
Wet	35	394,401,991	69	499,156,621	893,558,612	52.7	39,934,495	22.4
Dry	38	493,998,226	49	308,847,721	802,845,947	47.3	36,807,075	21.8
	73	888,400,217	118	808,004,342	1,696,404,559	100.0	76,741,570	22.1
Percent of total electrical energy used	-------	52.4	-------	47.6	100.0	------	----------	----------

HIGH-EARLY-STRENGTH PORTLAND CEMENT

Manufacturing processes have been modified at many plants to produce portland cements that will attain high strength in a much shorter time than ordinary cements. Large quantities of such cements are now sold, particularly for projects in which the time factor is of great importance. Shipments in 1935 totaled 2,109,000 barrels valued at $4,032,000. The following table shows shipments of such cements quarterly in 1936.

High-early-strength portland cement shipped from mills in the United States in 1936

Period	Number of shipping plants	Quantity (barrels)	Estimated mill value
First quarter	46	461,000	$870,000
Second quarter	51	897,000	1,721,000
Third quarter	51	818,000	1,577,000
Fourth quarter	51	839,000	1,601,000
	51	3,015,000	5,769,000

NATURAL, MASONRY (NATURAL), AND PUZZOLAN CEMENTS

The term "masonry cement" is used here to designate certain cements made by grinding calcined calcareous rock (as are natural cements) and used largely in mortar for laying brick and stone, although other hydraulic cements also are suitable for masonry and are being manufactured for this purpose in increasing quantities.

Puzzolan cements are made of natural or artificial materials capable of forming hydraulic cements simply by admixture with lime and without the use of heat. Slags and various forms of volcanic ash are the principal puzzolanic materials. Such cements find special uses be-

cause of their high resistance to sulphate and alkali waters. The following table shows production of natural and puzzolan cements in recent years.

Natural, masonry (natural), and puzzolan cements produced, shipped, and in stock at mills in the United States, 1932–36

Year	Production		Shipments		Stock (Dec. 31)
	Active plants	Barrels (376 pounds)	Barrels (376 pounds)	Value	Barrels (376 pounds)
1932	15	456,785	524,844	$696,474	150,164
1933	13	466,632	432,415	571,648	182,686
1934	14	671,588	678,204	960,732	175,865
1935	13	1,006,064	1,011,411	1,437,542	[1] 171,775
1936	13	1,725,810	1,663,942	2,249,866	233,643

[1] Revised figure.

TECHNOLOGY

Improved grinding, better proportioning of raw materials, storage of mixed clinker, more attention to what happens inside the kiln during firing, clinker cooling, preheating of combustion air, and dust collection are all receiving careful attention in the cement industry, judging from the record of plant improvements during 1936. Increased flexibility of operations is another goal, and more companies are giving thought to the production of special cements.

Definition.—Recognizing the importance of high-early-strength portland cement, Committee C–1 of the American Society for Testing Materials has proposed the following definition:

> Portland cement is the product obtained by pulverizing clinker consisting essentially of calcium silicates, to which no additions have been made subsequent to calcination other than water and/or untreated calcium sulphate except that additions not to exceed 1 percent of other materials may be added, provided such materials have been shown not to be harmful by tests prescribed and carried out by Committee C–1.

Byproducts.—The Oklahoma Portland Cement Co., Ada, Okla., is shipping 10 to 15 tons of solid carbon dioxide a day as a byproduct.

Kiln insulation.—By investing $3,990 for insulation in its Clinchfield (Ga.) plant, the Pennsylvania-Dixie Cement Corporation has saved $24,030 in coal costs in 6 years.[3]

Basset process.—The first actual installation of a rotary kiln for the simultaneous production of iron and portland cement is at the cement plant of the Compania Asland, Moncada, Spain. The raw materials are iron ore, limestone, and coke breeze or anthracite. The kiln is 45 meters long and 2.8 meters in diameter. After the usual reactions are completed in the cement kiln at 1,400° C., corresponding to the sintering-zone temperature in ordinary portland-cement manufacture, the material passes on to the hottest zone where it reaches 1,500° C.; this melts the iron, part of which flows out through an opening in the shell and part of which is removed subsequently by passing the cooled clinker over a magnetic separator. The cement so produced meets the Spanish standard specifications for portland cement.[4]

[3] Rock Products, Rotary Kiln Insulation Pays: Vol. 39, no. 8, August 1936, p. 47.
[4] Pit and Quarry, Rotary Kiln Produces Both Cement and Iron: Vol. 28, no. 12, June 1936, p. 71.

Seasoning.—According to Roller[5] portland cement absorbs water vapor from an atmosphere of steam at temperatures above the dew point; the rate is rapid during the first few minutes of exposure and then declines. For steam-air mixtures the quantity of moisture absorbed depends solely on the ratio of absolute temperature of exposure to that of the dew point. Progressive absorption up to a certain limit retards the set and reduces the proportion of mixing water required for normal consistency. When corrections were made to allow for the effect of gypsum admixture, cements that had absorbed least moisture had the lowest strengths. Cements that had absorbed most moisture also had the greatest resistance to the action of carbon dioxide at room temperature. The advantages of controlled sintering at elevated temperatures are indicated.

Special cements.—The construction of enormous dams during recent years has led to intensive research on the best types of cement for mass concrete work. The first major efforts were directed toward a reduction in the heat of hydration by development of a "low heat" type. This was accomplished by decreasing the cement compounds responsible for most of the generation of heat, namely, the tricalcium silicate and tricalcium aluminate. Such reduction necessitated an increase in the percentages of dicalcium silicate and tetracalcium aluminoferrite, which resulted in a much slower development of strength. The slow attainment of strength in these low-heat cements is accelerated somewhat by fine grinding. This type of cement was used in the Morris Dam in California and the Boulder Dam on the Colorado River.

Because of the slow gain in strength of low-heat cement a compromise product known as the modified or moderate-heat type was developed. It reverted to standard portland cement in its content of tricalcium and dicalcium silicates but retained the low percentage of tricalcium aluminate used in low-heat cement. This moderate-heat type with very fine grinding develops strength at about the same rate as standard portland cement, attains higher ultimate strength in mass concrete work, and generates 10 percent less heat than standard cement, whereas the low-heat type develops 27 percent less heat. Moderate-heat cement was used in the Norris Dam in Tennessee and is being used in the Grand Coulee Dam in Washington.

FOREIGN TRADE[6]

Imports.—The figures in the two following tables cover imports of hydraulic cements of all kinds. The values assigned to imports, supposed to represent values in the foreign countries from which the materials are exported, include the cost of containers. The first table shows total imports for a series of years, and the second, imports by countries and by districts of entry in 1935 and 1936.

Hydraulic cement imported for consumption in the United States, 1932–36

Year	Barrels	Value	Year	Barrels	Value
1932	468,139	$363,247	1935	619,403	$615,866
1933	477,193	400,153	1936	1,658,902	1,421,620
1934	265,997	264,416			

[5] Roller, P. S., Seasoning of Portland Cement at Elevated Temperatures: Ind. Eng. Chem., Vol. 28, 1936, pp. 362–369.

[6] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Roman, portland, and other hydraulic cements imported for consumption in the United States, 1935-36, by countries and districts

	1935		1936	
	Barrels	Value	Barrels	Value
COUNTRY				
Belgium	238,356	$228,925	846,172	$701,867
Canada	1,430	4,145	2,325	7,043
Denmark	213,909	236,136	328,958	317,325
France	4,722	11,215	1,110	2,998
Germany	74,545	59,258	257,048	190,954
Japan	21,261	19,803	38,640	35,041
Mexico	564	1,155	446	1,016
Netherlands			44,107	28,024
Norway	20,125	14,434	31,002	21,740
Poland and Danzig	9,271	7,610	45,913	39,799
U. S. S. R. (Russia)	30,212	16,560		
United Kingdom	2,527	9,675	14,544	26,011
Yugoslavia	100	160	43,496	33,709
	617,022	609,076	1,653,761	1,405,527
DISTRICT				
Connecticut			7,580	6,730
Dakota	14	51	62	227
El Paso			5	6
Florida	94,799	111,070	351,266	310,634
Galveston	1,175	964	100	80
Georgia	800	597	70,362	52,201
Hawaii	20,859	19,299	38,236	34,571
Los Angeles	402	504	404	470
Maine and New Hampshire	792	2,561	3,149	7,049
Maryland	300	244	12,004	10,252
Massachusetts	88,152	85,170	181,713	131,931
Mobile	8,240	7,776	19,688	16,267
New Orleans	1,171	964	3,946	3,867
New York	230,446	233,209	571,141	527,191
North Carolina	2,490	3,243	9,179	11,234
Oregon	16,896	12,990	11,397	7,986
Philadelphia	4,180	3,777	48,721	31,578
Puerto Rico	127,104	104,222	245,913	184,267
Rhode Island			6,620	4,088
Sabine			2,100	1,769
St. Lawrence	620	1,523	558	1,449
San Antonio	6,486	5,850	9,669	10,088
San Francisco	1,273	1,628	1,810	1,068
South Carolina			34,305	28,387
Vermont	3	10	17	42
Virgin Islands	5,415	9,522	2,487	4,130
Virginia	500	622		
Washington	4,905	3,280	21,329	14,965
	617,022	609,076	1,653,761	1,405,527

The following table shows imports of white, nonstaining portland cement in 1936, by countries.

White, nonstaining portland cement imported for consumption in the United States in 1936, by countries

Country	Barrels	Value	Country	Barrels	Value
Belgium	1,617	$4,941	Germany	295	$1,063
Bulgaria	10	10	United Kingdom	1,147	4,701
Denmark	25	134			
France	2,047	5,244		5,141	16,093

Exports.—Although the United States is the major cement-producing country of the world, its export trade is small. The following table shows exports for a series of years and their relation to total shipments. Exports in 1936 were less than one-third of 1 percent of the total quantity shipped from domestic plants.

Hydraulic cement exported from the United States, 1932–36

Year	Barrels	Value	Percent of total shipments from mills
1932	374,581	$802,205	0.5
1933	680,307	1,487,707	1.1
1934	566,171	1,333,381	.7
1935	416,099	1,012,942	.6
1936	334,673	886,560	.3

The following table shows exports by country of destination in 1935 and 1936.

Hydraulic cement exported from the United States, 1935–36, by countries

Country	1935		1936	
	Barrels	Value	Barrels	Value
North America:				
Bermuda	287	$605	222	$910
Canada	6,536	31,630	9,591	47,478
Central America:				
British Honduras	1,234	4,003	1,005	1,478
Costa Rica	152	271	154	908
Guatemala	892	2,258	1,452	3,205
Honduras	40,233	56,279	17,836	28,154
Nicaragua	605	2,000	1,702	4,011
Panama	111,484	210,612	104,378	166,409
Salvador	125	586	638	3,187
Mexico	75,137	156,242	32,237	75,909
Newfoundland and Labrador	988	1,545	3,131	6,060
West Indies:				
British:				
Jamaica	102	537	81	373
Trinidad and Tobago	707	1,339	337	1,976
Other British	2,938	5,726	2,222	5,830
Cuba	8,132	31,318	9,340	39,994
Dominican Republic	2,561	4,729	1,724	3,685
French	105	114	274	337
Haiti	799	1,547	162	635
Netherland	7,507	12,232	591	2,120
	260,524	523,573	187,077	392,659
South America:				
Argentina	23,560	98,857	26,532	108,341
Bolivia	680	2,020	457	2,284
Brazil	10,228	45,512	16,134	63,986
Chile	4,898	25,307	2,934	14,812
Colombia	9,362	31,287	9,915	29,899
Ecuador	1,159	5,066	1,428	5,559
Guiana: French	660	1,420	495	1,065
Paraguay	140	718	139	704
Peru	2,142	8,379	2,017	9,186
Surinam	177	330		
Uruguay	5,270	23,630	3,776	15,127
Venezuela	76,815	154,230	60,854	141,409
	135,091	396,756	124,681	392,372
Europe:				
Azores and Madeira Islands			10	65
Belgium	1,509	6,910	1,008	4,442
Denmark			150	605
France			183	912
Greece			125	669
Irish Free State	330	1,440	270	1,221
Netherlands	858	3,041	322	1,845
Norway	35	240		
Portugal	34	238	55	718
Rumania			30	222
Spain			104	597
Sweden	6	33		
United Kingdom	4,883	18,992	7,624	31,177
	7,665	30,894	9,881	42,473

Hydraulic cement exported from the United States, 1935–36, by countries—Continued

Country	1935		1936	
	Barrels	Value	Barrels	Value
Asia:				
Arabia	666	$2,651	1,298	$4,451
British Malaya	408	1,909	53	294
China	122	660	261	2,474
Hong Kong	154	850	60	438
India, British	2,343	12,473	1,794	9,609
Japan	107	459	3	20
Netherland India	68	282	10	48
Palestine	5,734	30,567	1,292	7,141
Philippine Islands	86	447	927	4,684
Other Asia	480	2,123	3,371	14,878
	10,168	52,421	9,069	44,037
Africa:				
Egypt	22	125		
Union of South Africa	478	2,533	869	4,466
Portuguese. Mozambique	20	120		
	520	2,778	869	4,466
Oceania:				
British:				
Australia	891	3,735	1,777	7,277
New Zealand	828	1,864	344	1,563
French	422	921	975	1,713
	2,141	6,520	3,096	10,553
	416,099	1,012,942	334,673	886,560

Shipments of cement to outlying territories of the United States, shown in the following table, may be of interest to producers.

Domestic hydraulic cement shipped to noncontiguous territories of the United States, 1935–36

	1935		1936	
	Barrels	*Value*	*Barrels*	*Value*
Alaska	25,174	$71,285	24,955	$68,459
American Samoa	159	427	12	30
Guam			35	93
Hawaii	238,241	477,999	152,864	358,690
Puerto Rico	253,609	343,516	21,334	38,204
Virgin Islands	4,652	7,243	50	132
Wake Island	200	378	683	1,764
	522,035	900,848	199,933	467,372

WORLD PRODUCTION

The following table, copied from the Statistical Year Book of the League of Nations, 1935–36,[7] gives data on the cement output of the world from 1931 to 1935. The figures are in thousands of metric tons (1 metric ton equals 2,204.6 pounds).

For 1934, the latest year for which reasonably complete data are available, the principal cement-producing countries were, in order of importance: United States, Germany, United Kingdom, Japan, France, Italy, and U. S. S. R. (Russia). In that year the United States produced about 23 percent of the estimated output of the world.

[7] League of Nations, Statistical Year Book, 1935–36: Geneva, 1936, p. 129.

World production of cement, 1931–35, in thousands of metric tons [1]

Country	1931	1932	1933	1934	1935 [2]
North America:					
Canada	1,619	737	383	553	554
United States	21,604	13,166	10,905	13,363	13,170
Total North America	23,223	13,903	11,288	13,916	13,724
South America:					
Argentina	536	501	514	567	(3)
Brazil	167	149	222	324	363
Chile	102	112	139	203	285
Peru	28	21	27	46	(3)
Uruguay [4]	----------	[5] 157	[5] 136	(3)	(3)
Total South America [2]	833	783	902	1,140	(3)
Europe (excluding U. S. S. R. (Russia)):					
Austria	500	350	280	315	370
Belgium	2,465	2,100	1,950	1,900	2,200
Bulgaria	104	139	121	130	124
Czechoslovakia [2]	1,200	1,081	850	(3)	(3)
Denmark	509	415	554	770	(3)
Estonia	41	30	30	34	(3)
Finland	162	154	163	241	(3)
France	4,908	5,028	4,653	4,603	(3)
Germany [6]	3,711	2,795	3,464	5,989	(3)
Saar	126	93	111	155	(4)
Greece	195	196	200	248	(3)
Hungary	296	197	181	225	(3)
Italy	3,077	3,177	3,535	4,018	(3)
Latvia	71	50	52	70	72
Netherlands	200	254	360	394	360
Norway	220	235	222	249	260
Poland	546	354	411	721	801
Portugal	95	121	164	185	214
Rumania	196	213	220	314	361
Spain	1,630	1,425	1,407	1,362	(3)
Sweden	518	484	403	583	(3)
Turkey	100	108	118	169	(3)
United Kingdom	5,986	4,320	4,470	5,280	(3)
Yugoslavia	893	665	650	682	785
Total Europe (excluding U. S. S. R. (Russia)) [7]	28,600	24,800	25,300	30,300	(3)
U. S. S. R. (Russia)	3,336	3,481	2,749	3,559	4,470
Asia (excluding U. S. S. R. (Russia)):					
China [8]	235	192	270	229	(3)
French Indochina	152	171	113	115	107
India, British	588	592	623	749	870
Japan [9]	3,615	3,731	4,784	5,125	5,565
Netherland India	130	80	74	113	140
Palestine	84	100	135	143	187
Philippine Islands	95	114	95	(3)	(3)
Siam	58	52	44	51	49
Syria and Lebanon	[2] 10	44	58	78	101
Total Asia (excluding U. S. S. R. (Russia)) [2]	4,970	5,080	6,200	6,700	7,350
Africa:					
Algeria	77	88	(3)	(3)	(3)
Belgian Congo	45	16	11	10	----------
Egypt	245	243	250	297	379
Madagascar	----------	----------	5	13	4
Morocco (French)	150	220	201	184	180
Mozambique	24	25	21	12	(3)
Tunisia	----------	3	39	34	40
Total Africa	541	595	[2] 620	[2] 640	(3)
Oceania:					
Australia [2]	396	251	326	417	(3)
Other	154	149	174	183	(3)
Total Oceania [2]	550	400	500	600	(3)
Total production [2]	62,050	49,040	47,600	56,900	(3)

[1] The table covers, as far as possible, the total of natural and artificial cements, portland or other, compiled from national official statistics.
[2] Estimated.
[3] Data not yet available.
[4] Not included in the totals.
[5] 12 months ending June 30.
[6] Works affiliated with the German Cement Association.
[7] Total includes estmate for other countries not mentioned.
[8] Total shipments from "Customs ports" in China, excluding Manchuria.
[9] Includes Korea, Formosa, and Kwantung.

STONE[1]

By Oliver Bowles and A. T. Coons

SUMMARY OUTLINE

The stone industries experienced decided improvement in 1936. Dimension-stone sales gained 27 percent in quantity and 43 percent in value over 1935, while crushed-stone sales gained 48 percent in both quantity and value. The industry had reached such a low level of activity in 1935 that even with these large gains the sales value in 1936 was still only 64 percent of that attained in 1929.

Stone producers depend for their prosperity to an unusual degree on the volume of building and highway construction; therefore, they suffered greatly since 1929, during which period building activity has been sluggish. All branches of the industry shared in the recession, but some have recovered more rapidly than others.

The decline in the building-stone industry was sharper and more persistent than for most building materials. An increase in the value of construction contracts awarded, from a low of 25 percent of the 1923–25 average in 1933 to 37 percent in 1935 and 55 percent in 1936, has not brought about a corresponding recovery in the use of stone. Building-stone sales, in fact, declined moderately in quantity and very greatly in value from 1933 to 1935, but gained substantially in 1936. The delay in recovery may be attributed, at least in part, to an endeavor to keep building costs low, with consequent use of lower priced building materials at the expense of stone. Furthermore, Government building of large stone structures has declined, so that any gain in construction was chiefly in the field of residential building, in which only small quantities of stone are employed.

Crushed-stone sales recovered somewhat in 1934 and dropped again in 1935, but advanced to a higher level in 1936. The most substantial gains since 1933 have been made by Government agencies (noncommercial production). Therefore, the stone-producing industries have not experienced as great a recovery as the figures for total production would indicate.

The tables in this report give the quantities sold or used by producers and the values f. o. b. quarries and mills insofar as these figures

[1] Data for 1936 are preliminary; detailed statistics with final revisions will be released later.

are obtainable. Stone quarried and used by the producer is considered as sold and is included in the statistics on sales. The figures, however, do not include stone made into abrasives (such as grindstones) or that used in the manufacture of lime and cement. These amounts are reported in terms of finished products in the Abrasive Materials, Lime, and Cement chapters of this volume. The following table shows production of stone by kinds for the past 5 years.

Stone sold or used by producers in the United States, 1932–36, by kinds

[Quantities approximate]

Year	Granite		Basalt and related rocks (trap rock)		Marble		Limestone	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1932	5, 118, 550	$15, 978, 363	9, 328, 580	$8, 879, 702	342, 830	$7, 532, 309	46, 913, 520	$48, 015, 748
1933	4, 422, 250	11, 327, 371	7, 394, 290	6, 596, 248	224, 670	6, 399, 004	45, 922, 280	44, 499, 311
1934	6, 791, 850	14, 889, 155	11, 642, 830	11, 269, 853	177, 280	3, 370, 917	57, 501, 510	53, 790, 846
1935	6, 013, 990	13, 507, 165	9, 671, 950	9, 315, 040	132, 450	3, 415, 861	57, 492, 760	50, 668, 765
1936 [1]	13, 878, 000	20, 000, 000	11, 240, 000	10, 350, 000	162, 000	5, 678, 000	83, 048, 000	75, 625, 000

Year	Sandstone		Other stone [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1932	2, 973, 040	$4, 081, 804	5, 967, 790	$4, 575, 682	70, 614, 310	$89, 063, 608
1933	2, 799, 920	4, 145, 329	9, 458, 800	7, 978, 345	70, 222, 210	80, 945, 608
1934	3, 605, 420	4, 714, 284	12, 344, 940	10, 944, 881	92, 063, 830	98, 979, 936
1935	3, 009, 790	4, 568, 093	6, 838, 110	6, 349, 573	83, 159, 050	87, 824, 497
1936 [1]	6, 173, 000	9, 278, 000	7, 932, 000	8, 345, 000	122, 433, 000	129, 276, 000

[1] Subject to revision.
[2] Includes mica schist, conglomerate, argillite, various light-colored volcanic rocks, serpentine not used as marble, soapstone sold as dimension stone, and such other stone as cannot properly be classed in any main group.

The following table of production by uses indicates a substantial gain in all branches of the dimension-stone industries in 1936, except that for paving blocks, which fell about 27 percent in quantity below the level of 1935. Sales of crushed and broken stone show large gains. Sales of riprap more than doubled, principally because of the demand for such stone in the construction of large dams in the far West. Furnace- and refractory-stone sales advanced in consonance with the great activity in steel plants.

Stone sold or used by producers in the United States, 1935–36, by uses

Use	1935		1936 [1]	
	Quantity	Value	Quantity	Value
Dimension stone:				
Building stone……cubic feet	10, 548, 740	$6, 755, 445	13, 782, 000	$11, 929, 000
Approximate equivalent in short tons	830, 430		1, 036, 000	
Monumental stone……cubic feet	2, 169, 030	6, 561, 231	2, 647, 000	7, 643, 000
Approximate equivalent in short tons	179, 380		220, 000	
Paving blocks……number	8, 400, 940	792, 502	6, 162, 000	614, 000
Approximate equivalent in short tons	78, 310		65, 000	
Curbing……cubic feet	858, 640	793, 645	1, 153, 000	1, 173, 000
Approximate equivalent in short tons	69, 340		93, 000	
Flagging……cubic feet	315, 700	238, 933	425, 000	343, 000
Approximate equivalent in short tons	24, 340		32, 000	
Rubble……short tons	279, 100	375, 327	364, 000	505, 000
Total dimension stone (quantities approximate, in short tons)	1, 460, 900	15, 517, 083	1, 860, 000	22, 207, 000

[1] Subject to revision.

Stone sold or used by producers in the United States, 1935–36, by uses—Continued

Use	1935		1936 [1]	
	Quantity	Value	Quantity	Value
Crushed and broken stone:				
Riprap..........short tons..	4, 919, 110	$4, 494, 514	10, 900, 000	$7, 552, 000
Crushed stone..........do....	54, 754, 520	48, 899, 982	79, 300, 000	73, 862, 000
Furnace flux (limestone)..........do....	12, 191, 660	7, 902, 717	17, 630, 000	11, 675, 000
Refractory stone [2]..........do....	866, 320	1, 130, 232	1, 316, 000	1, 820, 000
Agriculture (limestone)..........do....	2, 140, 370	2, 656, 728	3, 411, 000	3, 840, 000
Manufacturing industries (limestone and marble) short tons..	5, 835, 290	5, 251, 820	8, 016, 000	8, 320, 000
Other uses [3]..........do..	990, 880	1, 971, 421		
Total crushed and broken stone..........do....	81, 698, 150	72, 307, 414	120, 573, 000	107, 069, 000
Grand total (quantities approximate, in short tons)	83, 159, 050	87, 824, 497	129, 433, 000	129, 276, 000

[1] Subject to revision.
[2] Ganister, sandstone, mica schist, soapstone, and dolomite.
[3] 1935: Includes 159,110 short tons of roofing granules valued at $775,241. There were also produced 166,520 tons of slate granules valued at $1,112,081 used for roofing and included in the chapter on Slate in Minerals Yearbook, 1936 1936: Segregation of stone granules not yet available; slate granules amounted to 202,730 tons valued at $1,372,095.

The following table shows production of all kinds of stone by States. In number of operators, Pennsylvania was first and Missouri second; in quantity produced, Pennsylvania was first and Michigan second; and in value of output, Pennsylvania led and New York was second.

Stone sold or used by producers in the United States in 1935, by States

State	Number of active plants	Short tons (approximate)	Value	State	Number of active plants	Short tons (approximate)	Value
Alabama	21	639, 700	$764, 027	Nevada	36	1, 093, 240	$491, 050
Alaska	2	(1)	(1)	New Hampshire	22	33, 050	188, 016
Arizona	17	192, 390	182, 638	New Jersey	36	[2] 1, 242, 000	[2] 1, 516, 372
Arkansas	11	335, 360	351, 531	New Mexico	[3] 10	[2] 1, 171, 800	[2] 890, 490
California	183	4, 178, 580	4, 169, 031	New York	198	[2] 7, 732, 550	[2] 7, 420, 225
Colorado	33	[2] 1, 021, 260	[2] 910, 141	North Carolina	95	1, 123, 240	1, 536, 192
Connecticut	34	[2] 1, 459, 220	[2] 1, 562, 585	North Dakota	1	(1)	(1)
Delaware	2	(1)	(1)	Ohio	176	[2] 6, 234, 840	[2] 5, 748, 188
District of Columbia	1	(1)	(1)	Oklahoma	37	734, 690	652, 366
Florida	35	[2] 1, 216, 390	[2] 1, 021, 497	Oregon	61	1, 204, 320	1, 017, 698
Georgia	34	1, 198, 610	2, 650, 556	Pennsylvania	312	8, 570, 050	8, 895, 606
Hawaii	11	[2] 191, 390	[2] 311, 870	Puerto Rico	[3] 11	97, 950	110, 216
Idaho	40	[2] 686, 480	[2] 631, 050	Rhode Island	10	[2] 158, 480	[2] 424, 314
Illinois	122	[2] 4, 405, 750	[2] 3, 230, 188	South Carolina	18	444, 180	874, 180
Indiana	108	[2] 1, 826, 830	[2] 3, 024, 414	South Dakota	31	229, 420	585, 434
Iowa	145	1, 840, 080	1, 645, 937	Tennessee	87	[2] 3, 063, 630	[2] 3, 083, 512
Kansas	132	[2] 1, 852, 170	[2] 1, 833, 763	Texas	75	[2] 1, 247, 970	[2] 1, 403, 754
Kentucky	93	[2] 1, 956, 810	[2] 1, 709, 330	Utah	15	215, 230	169, 865
Louisiana	2	(1)	(1)	Vermont	36	[2] 158, 590	[2] 3, 189, 170
Maine	32	[2] 151, 660	[2] 968, 675	Virginia	108	[2] 2, 901, 630	[2] 3, 274, 789
Maryland	36	[2] 623, 770	[2] 829, 915	Washington	121	3, 068, 360	2, 714, 282
Massachusetts	56	[2] 1, 848, 740	[2] 3, 204, 858	West Virginia	89	1, 897, 670	1, 745, 035
Michigan	25	[2] 8, 230, 930	[2] 4, 315, 462	Wisconsin	160	[2] 2, 495, 400	[2] 3, 117, 196
Minnesota	77	529, 670	1, 123, 061	Wyoming	13	265, 140	281, 718
Mississippi	1	(1)	(1)	Undistributed		730, 040	873, 761
Missouri	236	2, 263, 350	2, 695, 352		3, 292	83, 159, 050	87, 824, 497
Montana	30	[2] 193, 430	[2] 190, 382				
Nebraska	15	203, 210	294, 805				

[1] Included under "Undistributed".
[2] To avoid disclosing confidential information, certain State totals are slightly incomplete, the figures not included being combined under "Undistributed".
[3] Includes various portable plants operated noncommercially but combined as one plant.

DIMENSION STONE

The years 1934 and 1935 were about the worst in the history of the dimension-stone industries, but definite improvement took place in 1936. The recovery was shared by all the major varieties of stone. Total sales exceeded 2,000,000 tons valued at about $26,000,000 compared with about 1,560,000 tons valued at nearly $18,000,000 in 1935.

The principal kinds of dimension stone are granite, marble, limestone, sandstone, basalt, and slate. Although the slate industry is reviewed in a separate chapter, slate statistics are included in the table of salient statistics in this chapter to show total sales of dimension stone.

Dimension-stone producers may be divided into three main groups on the basis of plant operation; the first group includes operators who quarry stone and sell it as rough blocks or slabs; the second group quarries and manufactures stone into finished products; and the third buys sawed or rough stock and manufactures products but does not operate quarries.

The Bureau of Mines statistical canvass covers the first and second groups, but as the third group includes manufacturers rather than producers it is canvassed by the Bureau of the Census. Bureau of Mines statistics are compiled from reports of tonnages and values of original sales; it is evident, therefore, that they include some material sold as rough blocks and some sold as finished products.

The following table of salient statistics includes final figures for sales of dimension stone in 1935, preliminary figures for 1936, and the percentage of change from 1935 for each kind of stone by principal products.

Dimension stone sold or used by producers in the United States, 1935–36, by kinds and uses

Kind and use	1935	1936[1] Total	1936[1] Percent of change
Granite:			
Building stone:			
Rough construction.....short tons..	166,010	100,000	−39.8
Value	$317,717	$226,000	−28.9
Average per ton	$1.91	$2.26	+18.3
Cut stone, slabs, and mill blocks.....cubic feet..	500,080	753,000	+50.6
Value	$1,278,042	$1,831,000	+43.3
Average per cubic foot	$2.56	$2.43	−5.1
Monumental stone.....cubic feet..	1,868,660	2,295,000	+22.8
Value	$5,039,550	$5,965,000	+18.4
Average per cubic foot	$2.70	$2.60	−3.7
Rubble.....short tons..	50,280	65,000	+29.3
Value	$55,984	$78,000	+39.3
Paving blocks.....number..	8,111,660	5,810,000	−28.4
Value	$769,383	$590,000	−23.3
Curbing.....cubic feet..	599,280	820,000	+36.8
Value	$534,921	$850,000	+58.9
Total:			
Quantity.....approximate short tons..	536,000	546,000	+1.9
Value	$7,995,597	$9,540,000	+19.3
Basalt and related rocks (trap rock):			
Building stone.....short tons	3,930	13,000	+230.8
Value	$4,232	$32,000	+656.1
Average per ton	$1.08	$2.46	+127.8
Rubble.....short tons..	26,620	25,000	−6.1
Value	$15,571	$10,000	−35.8
Total:			
Quantity.....short tons..	30,550	38,000	+24.4
Value	$19,803	$42,000	+112.1
Marble:			
Building stone (cut stone, slabs, and mill blocks).....cubic feet.	368,450	784,000	+112.8
Value	$1,706,270	$3,780,000	+121.5
Average per cubic foot	$4.63	$4.82	+4.1
Monumental stone.....cubic feet.	300,370	352,000	+17.2
Value	$1,521,681	$1,678,000	+10.3
Average per cubic foot	$5.07	$4.77	−5.9
Total:			
Quantity.....approximate short tons..	56,710	97,000	+71.0
Value	$3,227,951	$5,458,000	+69.1
Limestone:			
Building stone:			
Rough construction.....short tons..	293,050	300,000	+2.4
Value	$310,878	$350,000	+12.6
Average per ton	$1.06	$1.17	+10.4
Cut stone, slabs, and mill blocks.....cubic feet.	3,243,820	5,580,000	+72.0
Value	$2,389,869	$4,350,000	+82.0
Average per cubic foot	$0.74	$0.78	+5.4
Rubble.....short tons..	185,790	250,000	+34.6
Value	$276,569	$375,000	+35.6
Flagging.....cubic feet..	93,700	100,000	+6.7
Value	$44,229	$55,000	+24.4
Total:			
Quantity.....approximate short tons	722,840	998,000	+38.1
Value	$3,021,545	$5,130,000	+69.8
Sandstone:			
Building stone:			
Rough construction.....short tons..	20,930	37,000	+76.8
Value	$62,501	$140,000	+124.0
Average per ton	$2.99	$3.78	+26.4
Cut stone, slabs, and mill blocks.....cubic feet..	348,400	470,000	+34.9
Value	$426,547	$710,000	+66.5
Average value per cubic foot	$1.22	$1.51	+23.8
Rubble.....short tons..	13,710	20,000	+45.9
Value	$24,206	$37,000	+52.9
Paving blocks.....number..	289,280	352,000	+21.7
Value	$23,119	$24,000	+3.8

See footnotes at end of table.

Dimension stone sold or used by producers in the United States, 1935–36, by kinds and uses—Continued

Kind and use	1935	1936[1] Total	1936[1] Percent of change
Sandstone—Continued			
Curbing ... cubic feet	259,360	333,000	+28.4
Value	$258,724	$323,000	+24.8
Flagging ... cubic feet	222,000	325,000	+46.4
Value	$194,704	$288,000	+47.9
Total:			
Quantity ... approximate short tons	100,840	146,000	+44.8
Value	$989,801	$1,522,000	+53.8
Miscellaneous stone:[2]			
Building stone ... cubic feet	133,910	360,000	+168.8
Value	$259,389	$510,000	+96.6
Average per cubic foot	$1.94	$1.42	−26.8
Rubble ... short tons	2,700	4,000	+48.1
Value	$2,997	$5,000	+66.8
Total:			
Quantity ... approximate short tons	13,960	35,000	+150.7
Value	$262,386	$515,000	+96.3
SUMMARY			
Dimension stone, exclusive of slate, by uses:			
Building stone:			
Rough construction ... short tons	483,920	450,000	−7.0
Value	$695,328	$748,000	+7.6
Cut stone, slabs, and mill blocks ... cubic feet	4,594,660	7,947,000	+73.0
Value	$6,060,117	$11,181,000	+84.5
Monumental stone ... cubic feet	2,169,030	2,647,000	+22.0
Value	$6,561,231	$7,643,000	+16.5
Paving blocks ... number	8,400,940	6,162,000	−26.7
Value	$792,502	$614,000	−22.5
Curbing ... cubic feet	858,640	1,153,000	+34.3
Value	$793,645	$1,173,000	+47.8
Flagging ... cubic feet	315,700	425,000	+34.6
Value	$238,933	$343,000	+43.6
Rubble ... short tons	279,100	364,000	+30.4
Value	$375,327	$505,000	+34.5
Total:			
Quantity ... approximate short tons	1,460,900	1,860,000	+27.3
Value	$15,517,083	$22,207,000	+43.1
Slate as dimension stone[3] ... approximate short tons	[4] 103,690	162,750	+57.0
Value	[4] $2,341,170	$3,838,428	+64.0
Grand total:			
Quantity ... approximate short tons	1,564,590	2,022,750	+29.3
Value	$17,858,253	$26,045,428	+45.8

[1] Subject to revision.
[2] Includes soapstone, mica schist, volcanic rocks, argillite, and other varieties that cannot properly be classed in any main group.
[3] Details of production, by uses, are given in the chapter on Slate in Minerals Yearbook, 1937.
[4] Revised figures.

Granite.—The granite industry gained in all branches except in paving-block manufacture. Building stone increased greatly in value although the quantity sold was much smaller. This was because sales of rough construction stone were reduced while sales of the higher-priced cut stone increased 50 percent. Demand for monumental stone and curbing increased encouragingly.

Sales of crushed and broken stone are included in this table and in corresponding tables for other kinds of stone, but these classes are discussed later in this chapter.

Granite sold or used by producers in the United States, 1935–36, by uses

Use	1935		1936 [1]	
	Quantity	Value	Quantity	Value
Building stone (rough and dressed)...cubic feet..	2,509,000	$1,595,759	1,953,000	$2,057,000
Approximate equivalent in short tons...	207,340	...	162,000	...
Monumental stone...cubic feet..	1,868,660	5,039,550	2,295,000	5,965,000
Approximate equivalent in short tons...	153,830	...	190,000	...
Paving...number of blocks..	8,111,660	769,383	5,810,000	590,000
Approximate equivalent in short tons...	75,070	...	61,000	...
Curbing...cubic feet..	599,280	534,921	820,000	850,000
Approximate equivalent in short tons...	49,480	...	68,000	...
Rubble...short tons..	50,280	55,984	65,000	78,000
Riprap...do...	802,340	685,950	[2] 6,720,000	[2] 3,520,000
Crushed stone...do...	4,653,970	4,767,887	6,570,000	6,900,000
Other uses...do...	21,680	57,731	42,000	40,000
Total (quantity approximate, in short tons)...	6,013,990	13,507,165	13,878,000	20,000,000

[1] Subject to revision.
[2] Includes a large amount of stone used in construction of a dam in California.

The table on page 1173 shows detailed data on sales by States and uses for 1935.

Granite sold or used by producers in the United States in 1935, by States and uses

State	Number of active plants	Building: Rough: Construction: Short tons	Building: Rough: Construction: Value	Building: Rough: Architectural: Cubic feet	Building: Rough: Architectural: Value	Building: Dressed: Cubic feet	Building: Dressed: Value	Monumental: Rough: Cubic feet	Monumental: Rough: Value	Monumental: Dressed: Cubic feet	Monumental: Dressed: Value	Paving blocks: Number	Paving blocks: Value
Arizona	2												
California	40	8,950	$11,348			80,120	$205,606	18,060	$32,438	6,350	$18,744	(1)	(1)
Colorado	11	(1)	(1)					(2)	(2)	[2] 7,520	[2] 40,472		
Connecticut	11	(1)	(1)	(2)	(2)	[2] 16,290	[2] 69,545	[3] 7,520	[3] 32,008	(3)	(3)	25,760	$2,023
Delaware	2	(1)	(1)										
District of Columbia	1												
Georgia	22					8,760	39,441	390,240	472,363	19,600	93,109	(1)	(1)
Maine	27	10,470	9,872	64,670	$50,424	90,180	187,375	2,520	3,430	2,120	8,420	5,356,800	547,063
Maryland	10	21,810	41,585			(1)	(1)					(1)	(1)
Massachusetts	27	80,980	149,563	(2)	(2)	[2] 57,200	[2] 241,829	[3] 81,890	[3] 211,258	(3)	(3)	1,915,820	156,803
Minnesota	23	1,360	9,805	[3] 53,240	[3] 106,053	(3)	(3)	118,170	239,713	30,320	203,763	(1)	(1)
Missouri	7	1,390	5,685	(1)	(1)	(1)	(1)	5,260	16,301			181,000	12,915
Montana	9			(1)	(1)	(1)	(1)	[3] 3,370	[3] 10,503	(3)	(3)		
New Hampshire	19	5,390	4,739	(2)	(2)	[2] 41,200	[2] 104,063	5,090	8,518	3,210	9,653	(1)	(1)
New Jersey	4	(1)	(1)			(1)	(1)			(1)	(1)		
New York	20	4,260	18,100			14,140	66,314	(1)	(1)				
North Carolina	52	1,700	2,224	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Oklahoma	5							(2)	(2)	[2] 19,410	[2] 169,233		
Oregon	2							(1)	(1)	(1)	(1)		
Pennsylvania	16	18,570	35,588	(1)	(1)	(1)	(1)	[3] 41,050	[3] 129,215	(3)	(3)	(1)	(1)
Rhode Island	6	1,090	719			(1)	(1)	[3] 43,910	[3] 194,618	(3)	(3)	(1)	(1)
South Carolina	9			(1)	(1)			(1)	(1)	(1)	(1)		
South Dakota	7			(1)	(1)			(2)	(2)	[2] 37,230	[2] 282,471		
Tennessee	3												
Texas	6	(1)	(1)	(1)	(1)	(1)	(1)	9,610	11,764	3,900	17,151		
Vermont	14			(1)	(1)	(1)	(1)	[3] 705,530	[3] 1,891,869	(3)	(3)		
Virginia	11	(1)	(1)										
Washington	17							[3] 2,640	[3] 18,047	(3)	(3)		
Wisconsin	21			(2)	(2)	[2] 13,280	[2] 49,169	16,520	23,196	43,800	489,918	(1)	(1)
Undistributed		10,040	28,489	34,060	28,523	26,940	69,680	235,020	353,178	8,800	58,167	632,280	50,579
	404	166,010	317,717	161,100	150,156	338,980	1,127,886	1,652,610	3,393,475	216,050	1,646,075	8,111,660	769,383

[1] Included under "Undistributed."
[2] Rough stone included under dressed stone.
[3] Dressed stone included under rough stone.

Granite sold or used by producers in the United States in 1935, by States and uses—Continued

State	Curbing		Rubble		Riprap		Crushed stone				Other uses		Total	
							Concrete and road metal		Railroad ballast					
	Cubic feet	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons (approximate)	Value
Arizona							(1)	(1)					(1)	(1)
California	2,420	$4,268	(1)	(1)	625,860	$503,330	404,780	$332,572	96,260	$44,080	(1)	(1)	1,146,230	$1,213,511
Colorado							42,350	44,873					43,040	85,725
Connecticut	7,270	7,847	(1)	(1)	(1)	(1)	(1)	(1)					24,920	149,525
Delaware			(1)	(1)	(1)	(1)	(1)	(1)					(1)	(1)
District of Columbia			(1)	(1)									(1)	(1)
Georgia	57,240	40,703	5,360	$12,862	(1)	(1)	462,940	421,440	(1)	(1)			563,000	1,122,029
Maine	60,760	52,738	(1)	(1)	14,060	10,556	30,670	40,650			(1)	(1)	122,940	911,776
Maryland	(1)	(1)	1,090	1,659	(1)	(1)	(1)	(1)					72,080	120,458
Massachusetts	392,400	332,400	(1)	(1)	15,390	22,871	416,480	528,772	(1)	(1)	(1)	(1)	595,560	1,660,006
Minnesota	(1)	(1)			2,670	1,138	(1)	(1)			(1)	(1)	41,300	591,224
Missouri					7,280	4,953							10,850	40,303
Montana							20,660	7,250					20,980	18,407
New Hampshire	7,930	7,985	(1)	(1)	(1)	(1)	10,660	13,299					22,800	152,176
New Jersey			200	450			33,110	43,922	(1)	(1)			52,480	64,611
New York	(1)	(1)	(1)	(1)	(1)	(1)	510,990	457,025	120,570	114,507			706,450	731,506
North Carolina	(1)	(1)	(1)	(1)	(1)	(1)	681,980	806,788	215,110	212,068			911,590	1,213,124
Oklahoma	(1)	(1)	(1)	(1)			(1)	(1)					48,910	200,698
Oregon													(1)	(1)
Pennsylvania	2,520	1,140	8,610	8,640	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	136,380	314,027
Rhode Island	(1)	(1)			(1)	(1)	36,300	37,224					45,140	273,295
South Carolina	(1)	(1)	(1)	(1)	(1)	(1)	254,530	354,892	134,720	124,646			416,500	834,409
South Dakota							(1)	(1)					3,270	284,185
Tennessee							21,790	17,978					21,790	17,978
Texas					(1)	(1)							22,040	47,413
Vermont							16,310	22,756					74,630	1,938,770
Virginia							434,280	553,592	(1)	(1)			495,280	616,092
Washington			(1)	(1)	3,770	1,623	230,980	119,801			(1)	(1)	243,170	165,923
Wisconsin					(1)	(1)	52,270	38,165			2,540	$12,465	61,210	615,173
Undistributed	68,740	87,840	35,020	32,373	133,310	141,479	292,360	314,338	133,870	117,249	19,140	45,266	111,450	124,821
	599,280	534,921	50,280	55,984	802,340	685,950	3,953,440	4,155,337	700,530	612,550	21,680	57,731	6,013,990	13,507,165

[1] Included under "Undistributed."

The district surrounding Barre, Vt., is the most productive area in the United States for memorial granite. Therefore, production figures as given in the following table are interesting.

Monumental granite sold by the quarrymen in the Barre district, Vermont, 1932–36 [1]

Year	Cubic feet	Value	Year	Cubic feet	Value
1932	618, 890	$1, 549, 113	1935	676, 820	$1, 844, 006
1933	563, 570	1, 405, 270	1936 [2]	797, 000	2, 187, 000
1934	709, 820	1, 878, 644			

[1] Barre granite is sold also for construction, paving blocks, and crushed stone.
[2] Subject to revision.

Basalt and related rocks (trap rock).—Basalt and related rocks are not used extensively for building purposes, but sales in 1936 were more than three times as great as in 1935. The following tables show production by uses in 1935 and 1936 and by States in 1935.

Basalt and related rocks (trap rock) sold or used by producers in the United States, 1935–36, by uses

Use			1936 [1]	
	Quantity	Value	Quantity	Value
Building stone ... cubic feet	46, 440	$4, 232	150, 000	$32, 000
Approximate equivalent in short tons	3, 930	------------	13, 000	------------
Rubble ... short tons	26, 620	15, 571	25, 000	10, 000
Riprap ... do	1, 080, 450	945, 394	650, 000	580, 000
Crushed stone ... do	8, 556, 610	8, 345, 422	10, 530, 000	9, 700, 000
Other uses ... do	4, 340	4, 421	22, 000	28, 000
Total (quantity approximate, in short tons)	9, 671, 950	9, 315, 040	11, 240, 000	10, 350, 000

[1] Subject to revision.

Basalt and related rocks (trap rock) sold or used by producers in the United States in 1935, by States and uses

State	Number of active plants	Building, rough construction		Rubble and riprap		Crushed stone				Other uses		Total	
						Concrete and road metal		Railroad ballast					
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Arizona	1					(1)	(1)					(1)	(1)
California	15	(1)	(1)	10,910	$9,951	315,460	$297,975	109,480	$64,476	(1)	(1)	439,230	$374,782
Connecticut	18	(1)	(1)	(1)	(1)	1,310,810	1,239,058	79,630	67,961			1,404,550	1,313,690
Hawaii	10			9,470	5,105	180,070	303,663	(1)	(1)	(1)	(1)	191,390	311,870
Idaho	30			(1)	(1)	648,020	577,721			(1)	(1)	650,240	578,674
Maryland	6			(1)	(1)	68,700	104,870	(1)	(1)			188,940	265,337
Massachusetts	15			(1)	(1)	876,360	881,686	(1)	(1)			903,890	907,182
Michigan	4					41,200	48,777					41,200	48,777
Minnesota	1			(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
New Hampshire	1					(1)	(1)					(1)	(1)
New Jersey	25	(1)	(1)	(1)	(1)	1,013,550	1,153,610	38,260	35,995			1,064,980	1,200,082
New York	3					(1)	(1)	(1)	(1)			589,930	627,444
Oregon	47	(1)	(1)	(1)	(1)	1,030,490	800,923					1,066,010	829,219
Pennsylvania	13	(1)	(1)	(1)	(1)	412,010	428,251	73,220	75,477	(1)	(1)	489,620	508,398
Texas	1			(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Virginia	4			(1)	(1)	34,210	46,518			(1)	(1)	35,450	48,443
Washington	75			1,013,060	891,663	1,418,170	1,190,732	(1)	(1)	(1)	(1)	2,439,820	2,093,851
Wisconsin	1			(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Undistributed		3,930	$4,232	73,630	54,246	635,470	700,514	271,500	327,215	4,340	$4,421	166,700	207,291
	270	3,930	4,232	1,107,070	960,965	7,984,520	7,774,298	572,090	571,124	4,340	4,421	9,671,950	9,315,040

[1] Included under "Undistributed."

Marble.—Sales of marble were more than twice as great in 1936 as in 1935, and the sales value per cubic foot increased from $4.63 to $4.82. Sales of monumental marble increased moderately.

Marble sold by producers in the United States, 1935–36, by uses

Use	1935		1936 [1]	
	Quantity	Value	Quantity	Value
Building stone:				
Rough:				
Exterior .... cubic feet..	26,800	$62,898	25,000	$31,000
Interior .... do....	21,900	53,904	105,000	307,000
Finished:				
Exterior .... do....	123,760	431,199	357,000	1,670,000
Interior .... do....	195,990	1,158,269	297,000	1,772,000
Total exterior .... do....	150,560	494,097	382,000	1,701,000
Total interior .... do....	217,890	1,212,173	402,000	2,079,000
Total building stone .... do....	368,450	1,706,270	784,000	3,780,000
Monumental stone:				
Rough .... do....	57,240	78,930	90,000	87,000
Finished .... do....	243,130	1,442,751	262,000	1,591,000
Total monumental stone .... do....	300,370	1,521,681	352,000	1,678,000
Total building and monumental .... do....	668,820	3,227,951	1,136,000	5,458,000
approximate short tons..	56,710	....	97,000	....
Marble for other uses (byproducts) .... short tons..	75,740	187,910	65,000	220,000
Total marble, approximate short tons	132,450	3,415,861	162,000	5,678,000

[1] Subject to revision.

Marble sold by producers in the United States in 1935, by States and uses

State	Building and monumental (rough and finished)		Other uses		Total	
	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
Alabama	18,530	$108,153	23,330	$42,486	24,920	$150,639
California	4,900	17,000	2,050	11,536	2,460	28,536
Georgia	186,810	943,276	7,150	7,154	23,020	950,430
Massachusetts	3,400	8,502	140	309	440	8,811
Missouri	87,900	175,985	6,420	3,827	13,740	179,812
New York	16,930	29,806	11,980	57,192	13,410	86,998
Tennessee	116,490	613,510	6,830	19,227	16,720	632,737
Vermont	194,870	1,130,267	14,720	19,186	31,290	1,149,453
Other States [1]	38,990	201,452	3,120	26,993	6,450	228,445
	668,820	3,227,951	75,740	187,910	132,450	3,415,861

[1] Arkansas, Colorado, Maryland, North Carolina, Utah, Virginia, and Washington.

Serpentine [1] (verde antique) sold by producers in the United States in 1935, by uses

Use	Quantity	Value
Building and ornamental stone .... cubic feet..	7,990	$87,657
Rough construction, crushed, etc .... short tons..	162,930	195,073

[1] Serpentine sold from dimension-stone quarries is included in the figures for marble; serpentine sold for ad work and other low-grade material is included in the figures for "miscellaneous" stone.

Limestone.—Sales of limestone for rough construction increased a little in 1936, while sales of cut stone increased greatly. More limestone is being used in private building. The following tables show sales by principal uses in 1935 and 1936 and more detailed data on the industry by States in 1935.

Limestone sold or used by producers in the United States, 1935–36, by uses

Use	1935		1936 [1]	
	Quantity	Value	Quantity	Value
Building stone [2] ... cubic feet	6,871,320	$2,700,747	9,580,000	$4,700,000
Approximate equivalent in short tons	529,810		740,000	
Curbing flagging and paving ... cubic feet	93,700	44,229	100,000	55,000
Approximate equivalent in short tons	7,240		8,000	
Rubble ... short tons	185,790	276,569	250,000	375,000
Riprap ... do	1,982,250	1,890.625	2,200,000	2,000,000
Crushed stone ... do	33,775,290	28,880,508	50,800,000	45,400,000
Fluxing stone ... do	12,191,660	7,902,717	17,630,000	11,675,00
Refractory stone ... do	321,860	265,506	400,000	385,000
Sugar factories ... do	460,460	640,375	541,000	757,000
Glass factories ... do	250,930	414,027	238,000	378,000
Paper mills ... do	188,090	339,372	230,000	360,000
Agriculture ... do	2,140,370	2,656,728	3,411,000	3,840,000
Other uses [3] ... do	5,459,010	4,657,362	6,600,000	5,700,000
Total (quantity approximate, in short tons)	57,492,760	50,668,765	83.048,000	75,625,000

[1] Subject to revision.
[2] Figures for building stone include small amounts of monumental stone.
[3] See table on p. 1196 for further distribution of limestone products.

Limestone sold or used by producers in the United States in 1935, by States and uses

State	Number of active plants	Building: Rough construction: Short tons	Building: Rough construction: Value	Building: Rough architectural: Cubic feet	Building: Rough architectural: Value	Building: Finished (cut and sawed): Cubic feet	Building: Finished (cut and sawed): Value	Rubble: Short tons	Rubble: Value	Riprap: Short tons	Riprap: Value	Crushed stone: Concrete and road metal: Short tons	Crushed stone: Concrete and road metal: Value	Crushed stone: Railroad ballast: Short tons	Crushed stone: Railroad ballast: Value
Alabama	14									(1)	(1)	91,900	$82,053		
Arizona	5											(1)	(1)	(1)	(1)
Arkansas	5									(1)	(1)	120,530	123,021	(1)	(1)
California	22	(1)	(1)					(1)	(1)	26,960	$66,586	55,730	59,020	(1)	(1)
Colorado	9			(1)	(1)										
Connecticut	4											(1)	(1)		
Florida	34					(1)	(1)			(1)	(1)	1,008,550	777,953	109,640	$74,317
Georgia	11											566,310	464,579		
Hawaii	1											(1)	(1)		
Idaho	5														
Illinois	115	10,090	$31,126					39,610	$43,948	214,220	213,880	2,965,850	2,106,582	389,650	257,572
Indiana	107	53,030	27,473	1,585,540	$423,996	1,179,900	$1,324,013			36,410	23,035	1,072,020	853,346	81,280	60,328
Iowa	145	5,070	3,685					1,790	1,623	53,220	44,267	1,641,290	1,447,369	(1)	(1)
Kansas	125	1,900	2,050	(1)	(1)	22,490	17,281	1,990	2,570	234,550	284,778	1,288,070	1,279,514	188,250	125,705
Kentucky	91			(1)	(1)	(1)	(1)	7,690	5,403	68,210	67,047	1,508,150	1,404,821	199,040	103,670
Louisiana	2											(1)	(1)	(1)	(1)
Maine	4											(1)	(1)		
Maryland	8	(1)	(1)									217,530	234,568		
Massachusetts	8														
Michigan	17	(1)	(1)							299,370	162,789	842,040	409,750	27,430	19,683
Minnesota	51	(1)	(1)	38,200	23,266	56,820	116,130	7,810	4,632	167,510	99,339	224,850	168,634		
Mississippi	1														
Missouri	221	22,580	40,608					53,580	89,425	408,470	442,043	1,446,950	1,479,435	86,890	78,871
Montana	6			(1)	(1)							(1)	(1)		
Nebraska	15	(1)	(1)							109,970	133,035	71,530	84,303		
Nevada	3											(1)	(1)		
New Jersey	3											(1)	(1)		
New Mexico	8									(1)	(1)	53,830	40,843	(1)	(1)
New York	95	30,360	39,621							141,840	146,464	4,258,780	4,027,677	565,270	362,854
North Carolina	2											(1)	(1)		
Ohio	158	8,650	13,197					(1)	(1)	(1)	(1)	3,029,590	2,536,964	387,530	265,757
Oklahoma	22									23,080	17,112	489,950	317,388	132,360	77,988
Oregon	4											(1)	(1)		
Pennsylvania	178	5,960	7,738					(1)	(1)	(1)	(1)	2,310,610	2,431,232	204,160	199,369
Puerto Rico	8							2,610	3,087			22,200	32,129	5,870	4,184

Limestone sold or used by producers in the United States in 1935, by States and uses—Continued

State	Number of active plants	Building: Rough construction: Short tons	Building: Rough construction: Value	Building: Rough architectural: Cubic feet	Building: Rough architectural: Value	Building: Finished (cut and sawed): Cubic feet	Building: Finished (cut and sawed): Value	Rubble: Short tons	Rubble: Value	Riprap: Short tons	Riprap: Value	Crushed stone: Concrete and road metal: Short tons	Crushed stone: Concrete and road metal: Value	Crushed stone: Railroad ballast: Short tons	Crushed stone: Railroad ballast: Value
Rhode Island	1														
South Carolina	2											(1)	(1)		
South Dakota	8									(1)	(1)	46,350	$53,263		
Tennessee	68									16,330	$29,286	2,470,760	1,825,028	284,540	$203,214
Texas	48	(1)	(1)	(1)	(1)	(1)	(1)			35,980	35,803	696,600	661,559	183,890	117,861
Utah	13											38,960	63,155	1,010	743
Vermont	8											35,600	60,929		
Virginia	73							9,780	$13,822	(1)	(1)	1,041,560	1,003,494	417,800	330,673
Washington	8							(1)	(1)			(1)	(1)		
West Virginia	57											598,370	718,421	152,770	92,984
Wisconsin	123	107,150	$77,323	98,440	$74,397			4,820	19,607	117,400	104,819	1,557,980	1,216,568	54,240	41,069
Wyoming	8			(1)	(1)					6,780	2,950	112,080	95,236	19,100	4,623
Undistributed		48,260	68,057	73,180	45,382	189,250	$365,404	56,110	92,452	21,950	17,392	268,070	295,727	132,780	104,484
	1,924	293,050	310,878	1,795,360	567,041	1,448,460	1,822,828	185,790	276,569	1,982,250	1,890,625	30,151,790	26,354,559	3,623,500	2,525,949

[1] Included under "Undistributed."

Limestone sold or used by producers in the United States in 1935, by States and uses—Continued

State	Fluxing stone		Sugar factories		Glass factories		Paper mills		Agriculture		Other uses		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons (approximate)	Value
Alabama	364,760	$352,329							44,670	$61,209	(1)	(1)	506,910	$509,981
Arizona	1,790	2,086											37,290	55,036
Arkansas									(1)	(1)			163,980	165,155
California	15,660	25,058	87,280	$199,022	19,790	$49,498			680	1,600	65,300	$186,859	326,550	681,192
Colorado	(1)	(1)	52,470	71,961							(1)	(1)	280,780	165,610
Connecticut	(1)	(1)			(1)	(1)			21,720	79,660	5,050	13,824	29,750	99,370
Florida									23,240	72,342	72,490	55,450	1,216,390	1,021,497
Georgia	(1)	(1)							31,520	48,932	(1)	(1)	612,590	578,097
Hawaii													(1)	(1)
Idaho	(1)	(1)	21,100	36,467							(1)	(1)	24,110	43,420
Illinois	336,240	175,567							349,690	246,935	82,800	141,709	4,387,350	3,217,319
Indiana	48,530	28,916	(1)	(1)	(1)	(1)			194,810	155,757	123,000	111,489	1,826,830	3,024,414
Iowa	9,520	7,939	12,290	21,453					104,080	82,107	12,030	36,870	1,840,080	1,645,937
Kansas									3,780	2,742	65,290	42,786	1,786,180	1,759,198
Kentucky	(1)	(1)							156,740	86,754	15,710	23,270	1,956,810	1,709,330
Louisiana									(1)	(1)	(1)	(1)	(1)	(1)
Maine	(1)	(1)					(1)	(1)	(1)	(1)			28,720	56,899
Maryland									(1)	(1)	24,370	45,125	244,150	286,210
Massachusetts	9,320	13,727							29,860	103,292	31,050	125,751	70,230	242,770
Michigan	3,778,300	1,875,801	(1)	(1)	(1)	(1)	(1)	(1)	67,310	37,103	2,977,470	1,480,922	8,175,430	4,159,915
Minnesota	(1)	(1)							55,200	54,292	(1)	(1)	467,360	479,175
Mississippi									(1)	(1)			(1)	(1)
Missouri	17,510	28,542	(1)	(1)	(1)	(1)			47,190	45,638	81,050	190,761	2,221,950	2,452,036
Montana	(1)	(1)	16,220	22,131							(1)	(1)	64,430	62,951
Nebraska			(1)	(1)					(1)	(1)	10,650	63,129	203,210	294,805
Nevada	(1)	(1)	(1)	(1)							(1)	(1)	57,170	69,477
New Jersey	(1)	(1)							(1)	(1)	(1)	(1)	91,320	216,601
New Mexico													80,140	54,030
New York	(1)	(1)					(1)	(1)	45,600	148,583	1,104,640	662,397	6,215,450	5,511,867
North Carolina													(1)	(1)
Ohio	1,988,970	1,227,561	1,550	1,892	118,080	190,262	(1)	(1)	157,720	202,497	166,800	230,800	5,874,150	4,686,872
Oklahoma					(1)	(1)			(1)	(1)			647,450	419,878
Oregon							(1)	(1)	5,420	24,396	890	4,911	20,710	50,759
Pennsylvania	4,013,520	3,096,464			44,880	98,432	14,730	$14,225	131,050	311,699	266,480	665,268	6,993,440	6,826,874
Puerto Rico													30,680	39,400
Rhode Island	(1)	(1)											(1)	(1)
South Carolina									(1)	(1)	(1)	(1)	(1)	(1)
South Dakota			(1)	(1)									51,610	57,541
Tennessee	10,970	12,320			(1)	(1)			181,870	251,360	(1)	(1)	3,001,760	2,373,975

Limestone sold or used by producers in the United States in 1935, by States and uses—Continued

State	Fluxing stone		Sugar factories		Glass factories		Paper mills		Agriculture		Other uses		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons (approximate)	Value
Texas	31,090	$22,901							(1)	(1)	34,890	$19,897	1,000,400	$1,188,752
Utah	151,260	46,919	20,240	$34,667							3,310	17,103	214,780	162,587
Vermont	(1)	(1)					(1)	(1)	(1)	(1)	2,030	15,922	43,320	93,936
Virginia	214,920	183,071					(1)	(1)	135,650	$164,296	316,970	376,458	2,160,290	2,089,997
Washington	(1)	(1)	(1)	(1)			48,260	$98,189	1,510	5,967	420	1,912	123,340	175,450
West Virginia	867,870	606,138			(1)	(1)			(1)	(1)	96,320	88,065	1,719,990	1,516,096
Wisconsin	(1)	(1)					(1)	(1)	296,150	324,935	40,990	68,072	2,190,620	1,930,098
Wyoming	(1)	(1)	93,110	130,353									232,380	244,537
Undistributed	331,430	197,378	156,200	122,429	68,180	$75,835	125,100	226,958	54,910	144,632	188,110	298,347	272,680	249,721
	12,191,660	7,902,717	460,460	640,375	250,930	414,027	188,090	339,372	2,140,370	2,656,728	5,788,110	4,967,097	57,492,760	50,668,765

(1) Included under "Undistributed."

Indiana leads all States as a producer of building limestone. Therefore considerable detail that has been assembled covering the industry in the Bedford and Bloomington districts is presented in the following tables.

Limestone sold by producers in the Indiana oolitic limestone district, 1932–36

Year	Construction		Other		Total	
	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
1932	5,927,350	$5,491,276	136,130	$85,957	565,860	$5,577,233
1933	4,858,660	4,817,822	150,140	80,961	502,400	4,898,783
1934	2,795,510	2,687,182	183,510	94,611	386,510	2,781,793
1935	2,764,870	1,747,245	160,000	107,000	367,000	1,854,245
1936 [1]	4,832,000	3,138,000	246,000	231,000	597,000	3,369,000

[1] Subject to revision.

Indiana limestone sold by mills not operated by quarry companies and by mills of quarry companies from stock obtained at quarries other than their own, 1932–36

Year	Cubic feet	Value	Year	Cubic feet	Value
1932	1,404,310	$2,375,274	1935	596,630	$855,621
1933	1,198,430	1,900,414	1936 [1]	1,854,000	2,285,000
1934	648,750	1,131,677			

[1] Subject to revision.

Limestone sold by producers in the Indiana oolitic limestone district, 1935–36, by classes

Class	1935		1936 [1]	
	Quantity	Value	Quantity	Value
Construction:				
Rough blocks ... cubic feet	1,585,150	$423,741	2,347,000	$698,000
Sawed and semifinished ... do	591,850	359,942	1,029,000	578,000
Cut ... do	587,870	963,562	1,456,000	1,862,000
Total construction ... do	2,764,870	1,747,245	4,832,000	3,138,000
Other stone ... short tons	160,000	107,000	246,000	231,000
Grand total (quantity approximate, in short tons)	367,000	1,854,245	597,000	3,369,000

[1] Subject to revision.

Indiana limestone sold by mills not operated by quarry companies and by mills of quarry companies from stock obtained at quarries other than their own, 1935–36, by classes

Sales by mills—	Sawed and semifinished		Cut		Total	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
1935						
Not operated by quarry companies	6,490	$4,151	329,890	$474,130	336,380	$478,281
Of quarry companies from stock obtained at quarries other than their own	53,460	19,058	206,790	358,282	260,250	377,340
	59,950	23,209	536,680	832,412	596,630	855,621
1936 [1]						
Not operated by quarry companies	137,000	165,000	655,000	984,000	792,000	1,149,000
Of quarry companies from stock obtained at quarries other than their own	324,000	163,000	738,000	973,000	1,062,000	1,136,000
	461,000	328,000	1,393,000	1,957,000	1,854,000	2,285,000

[1] Subject to revision.

Sandstone.—Sales of sandstone for rough construction in 1936 increased 77 percent in quantity and 124 percent in value over those of 1935. Prices sagged greatly in 1935 but recovered encouragingly in 1936. Ohio is the leading producer. The variety known as bluestone that is characteristic of certain districts in New York and Pennsylvania is covered in one of the tables that follow.

Sandstone sold or used by producers in the United States, 1935–36, by uses

Use	1935		1936 [1]	
	Quantity	Value	Quantity	Value
Building stone ... cubic feet	619,620	$489,048	955,000	$850,000
Approximate equivalent in short tons	46,930		73,000	
Paving blocks ... number	289,280	23,119	352,000	24,000
Approximate equivalent in short tons	3,240		4,000	
Curbing ... cubic feet	259,360	258,724	333,000	323,000
Approximate equivalent in short tons	19,860		25,000	
Flagging ... cubic feet	222,000	194,704	325,000	288,000
Approximate equivalent in short tons	17,100		24,000	
Crushed stone ... short tons	1,855,780	1,978,948	4,400,000	5,862,000
Rubble ... do	13,710	24,206	20,000	37,000
Riprap ... do	347,500	401,205	554,000	457,000
Refractory stone (ganister, etc.) ... do	525,320	709,286	885,000	1,265,000
Other uses ... do	180,350	488,853	188,000	172,000
Total (quantity approximate, in short tons)	3,009,790	4,568,093	6,173,000	9,278,000

[1] Subject to revision.

Sandstone sold or used by producers in the United States in 1935, by States and uses

State	Number of active plants	Building						Refractory stone (ganister)		Paving blocks		Curbing	
		Rough construction		Rough architectural		Dressed (sawed and cut)							
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Number	Value	Cubic feet	Value
Alabama	4							(1)	(1)				
Arizona	3	250	$100										
Arkansas	2												
California	18	(1)	(1)	(1)	(1)			(1)	(1)				
Colorado	7	(1)	(1)	(1)	(1)			6,290	$8,713				
Connecticut	1			(1)	(1)	(1)	(1)						
Idaho	2	(1)	(1)										
Illinois	5							(1)	(1)				
Kansas	6	(1)	(1)										
Kentucky	2					(1)	(1)	(1)	(1)				
Maryland	5	(1)	(1)					(1)	(1)				
Michigan	1												
Minnesota	1												
Missouri	1												
Montana	3							(1)	(1)				
New Jersey	1	(1)	(1)										
New Mexico	1												
New York	58	2,010	8,420	27,150	$11,292	20,560	$54,425			120,860	$8,839	90,770	$91,648
North Carolina	7												
Ohio	16	4,450	29,550	64,140	32,483	195,380	271,296	(1)	(1)			(1)	(1)
Oklahoma	8												
Oregon	2												
Pennsylvania	52	5,870	12,528	890	2,714			318,140	400,368	168,420	14,280	(1)	(1)
South Carolina	6												
South Dakota	10	(1)	(1)			(1)	(1)						
Tennessee	6			(1)	(1)								
Texas	7												
Utah	1												
Vermont	2												
Virginia	8												
Washington	1			(1)	(1)	(1)	(1)						
West Virginia	32							(1)	(1)				
Wisconsin	8	910	1,295	(1)	(1)			106,850	112,229				
Wyoming	2												
Undistributed		7,440	10,608	23,260	15,155	17,020	39,182	94,040	187,976			168,590	167,076
	289	20,930	62,501	115,440	61,644	232,960	364,903	525,320	709,286	289,280	23,119	259,360	258,724

[1] Included under "Undistributed."

Sandstone sold or used by producers in the United States in 1935, by States and uses—Continued

State	Flagging		Rubble		Riprap		Crushed stone				Other uses		Total	
							Concrete and road metal		Railroad ballast					
	Cubic feet	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons (approximate)	Value
Alabama							([1])	([1])					107,870	$103,407
Arizona					([1])	([1])	([1])	([1])					49,970	25,711
Arkansas							([1])	([1])					([1])	([1])
California	7,270	$4,200	([1])	([1])	17,890	$19,555	340,790	$330,605	([1])	([1])	54,730	$40,181	445,550	433,250
Colorado	([1])	([1])			([1])	([1])	49,130	41,602					103,960	84,546
Connecticut	([1])	([1])	([1])	([1])	([1])	([1])							([1])	([1])
Idaho			([1])	([1])									([1])	([1])
Illinois					([1])	([1])	17,500	7,871					18,400	12,869
Kansas	([1])	([1])					62,860	67,458			([1])	([1])	65,990	74,565
Kentucky							([1])	([1])					([1])	([1])
Maryland	([1])	([1])					27,210	37,192					29,040	39,525
Michigan							([1])	([1])					([1])	([1])
Minnesota					([1])	([1])	([1])	([1])	([1])	([1])	([1])	([1])	([1])	([1])
Missouri					([1])	([1])							([1])	([1])
Montana					([1])	([1])							([1])	([1])
New Jersey													([1])	([1])
New Mexico									([1])	([1])			([1])	([1])
New York	79,430	50,578			6,570	2,643	177,470	232,075			1,820	2,490	207,310	462,410
North Carolina							17,280	14,431					17,280	14,431
Ohio	89,210	90,719	([1])	([1])	229,210	312,009	66,730	65,968			([1])	([1])	360,690	1,061,316
Oklahoma			([1])	([1])			([1])	([1])					([1])	([1])
Oregon							([1])	([1])					([1])	([1])
Pennsylvania	24,410	13,059	2,580	$2,515	17,680	17,012	250,590	309,205	46,510	$44,922	([1])	([1])	657,010	837,397
South Carolina							([1])	([1])					([1])	([1])
South Dakota	([1])	([1])			([1])	([1])	151,700	190,510	1,430	1,573			154,430	220,795
Tennessee	13,460	39,219	([1])	([1])			([1])	([1])					23,360	58,822
Texas					180	263	32,940	33,985					33,120	34,248
Utah							([1])	([1])					([1])	([1])
Vermont							([1])	([1])					([1])	([1])
Virginia							104,940	103,030	([1])	([1])	([1])	([1])	160,020	132,368
Washington	([1])	([1])			([1])	([1])							([1])	([1])
West Virginia			([1])	([1])			118,970	167,235					177,680	228,939
Wisconsin	([1])	([1])	([1])	([1])			([1])	([1])			([1])	([1])	214,850	558,867
Wyoming							12,680	16,084					12,680	16,084
Undistributed	8,220	5,929	11,130	21,691	75,970	49,723	227,140	189,505	149,910	125,697	123,800	446,182	170,580	168,543
	222,000	194,704	13,710	24,206	347,500	401,205	1,657,930	1,806,756	197,850	172,192	180,350	488,853	3,009,790	4,568,093

[1] Included under "Undistributed."

Bluestone sold in New York and Pennsylvania in 1935, by uses [1]

State	Building stone		Curbing		Flagging		Other		Total	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
New York	47,560	$62,564	68,090	$78,674	79,280	$50,424	49,250	$68,468	65,690	$260,130
Pennsylvania	2,460	356	(2)	(2)	[2] 17,760	[2] 11,519	350	574	1,940	12,449
	50,020	62,920	[2] 68,090	[2] 78,674	[2] 97,040	[2] 61,943	49,600	69,042	67,630	272,579

[1] Figures included in foregoing for sandstone.
[2] A small amount of curbing is included under flagging.

Miscellaneous stone.—Production of various types of stone that do not fall in any of the groups already discussed is shown in the following tables.

Miscellaneous varieties of stone [1] *sold or used by producers in the United States, 1935–36, by uses*

Use	1935		1936 [2]	
	Quantity	Value	Quantity	Value
Building stone ... cubic feet	133,910	$259,389	360,000	$510,000
Approximate equivalent in short tons	11,260		31,000	
Riprap and rubble ... short tons	709,270	574,337	780,000	1,000,000
Crushed stone ... do	5,912,870	4,927,217	7,000,000	6,000,000
Refractory stone (mica schist and soapstone) ... do	19,140	155,440	31,000	170,000
Other uses ... do	185,570	433,190	90,000	665,000
Total (quantity approximate, in short tons)	6,838,110	6,349,573	7,932,000	8,345,000

[1] Includes mica schist, conglomerate, argillite, various light-colored volcanic rocks, serpentine not used as marble, soapstone used as dimension stone, refractory stone, and such other stone as cannot properly be classed in any main group.
[2] Subject to revision.

Miscellaneous varieties of stone sold or used by producers in the United States in 1935, by States and uses

State	Number of active plants	Building		Riprap and rubble		Crushed stone				Other uses		Total	
						Concrete and road metal		Railroad ballast					
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons (approximate)	Value
Alaska	2					(1)	(1)					(1)	(1)
Arizona	6					65,230	$76,473					65,230	$76,473
Arkansas	3					(1)	(1)	(1)	(1)			166,070	181,705
California	83	(1)	(1)	633,340	$521,699	1,018,100	764,243	(1)	(1)	112,180	$117,974	1,818,360	1,437,760
Colorado	5					593,480	574,260					593,480	574,260
Florida	1					(1)	(1)					(1)	(1)
Idaho	3			(1)	(1)	(1)	(1)	(1)	(1)			12,130	8,956
Illinois	2					(1)	(1)					(1)	(1)
Indiana	1					(1)	(1)					(1)	(1)
Kansas	1					(1)	(1)					(1)	(1)
Maine	1					(1)	(1)					(1)	(1)
Maryland	5	3,860	$15,043	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	89,560	118,385
Massachusetts	4					(1)	(1)	(1)	(1)			279,060	394,900
Michigan	3					(1)	(1)			(1)	(1)	14,300	106,770
Minnesota	1									(1)	(1)	(1)	(1)
Missouri	3					15,910	21,668					15,910	21,668
Montana	12					108,020	109,024					108,020	109,024
Nevada	33					1,036,070	421,573					1,036,070	421,573
New Hampshire	2					(1)	(1)			(1)	(1)	(1)	(1)
New Jersey	3	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)	33,220	35,078
New Mexico	[2] 1					1,091,660	836,460					1,091,660	836,460
New York	18	(1)	(1)			(1)	(1)					(1)	(1)
North Carolina	33					185,890	194,619					185,890	194,619
North Dakota	1					(1)	(1)					(1)	(1)
Ohio	2									(1)	(1)	(1)	(1)
Oklahoma	2					(1)	(1)			(1)	(1)	(1)	(1)
Oregon	6					93,300	121,101					93,300	121,101
Pennsylvania	53	(1)	(1)	(1)	(1)	250,450	242,833			42,950	166,332	293,600	408,910
Puerto Rico	[2] 3					67,270	70,816					67,270	70,816
Rhode Island	3					113,340	151,019					113,340	151,019
South Carolina	1					(1)	(1)					(1)	(1)
South Dakota	6					20,110	22,913					20,110	22,913
Tennessee	2					(1)	(1)					(1)	(1)
Texas	13					(1)	(1)	(1)	(1)			192,410	133,341
Vermont	4					9,350	7,011					9,350	7,011
Virginia	11	(1)	(1)	(1)	(1)	45,140	63,177			(1)	(1)	50,590	387,889
Washington	19			(1)	(1)	176,810	197,978	(1)	(1)	(1)	(1)	259,560	258,484
Wisconsin	7			(1)	(1)	(1)	(1)					28,720	13,058
Wyoming	3					20,080	21,097					20,080	21,097
Undistributed		7,400	244,346	75,930	52,638	829,620	901,798	173,040	$129,654	49,580	304,324	180,820	236,303
	362	11,260	259,389	709,270	574,337	5,739,830	4,797,563	173,040	129,654	204,710	588,630	6,838,110	6,349,573

[1] Included under "Undistributed."

[2] Includes various portable plants operated noncommercially but combined as 1 plant.

Trends in the use of building stone.—Dimension stone depends for its markets primarily on the building industries, principally on buildings of the nonresidential classes. Figures 82 and 83 show graphically the trends in sales of the principal building stones in relation to total building and nonresidential building from 1927 to 1936. The upturn in building in 1936 is reflected in the increasing activity in sales of stone. All classes of stone show substantial gains in sales, but marble sales increased most.

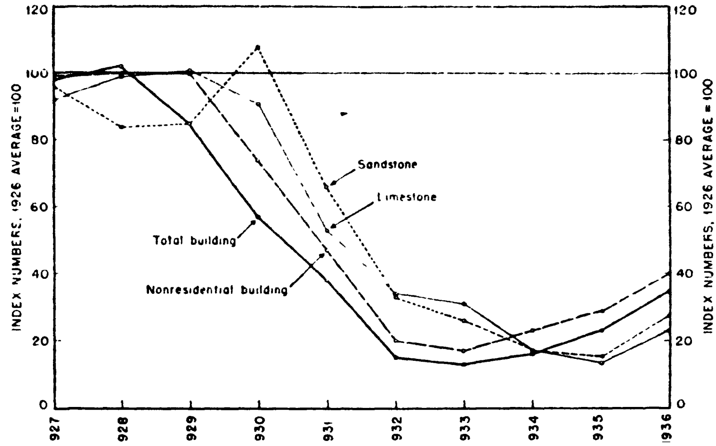


FIGURE 82.—Sales of limestone and sandstone, compared with total building and nonresidential building, 1927–36. To facilitate comparison, unlike units have been reduced to percentages of the 1927 value. Stone figures are from the Bureau of Mines and include rough and dressed stone; contracts are from F. W. Dodge Corporation.

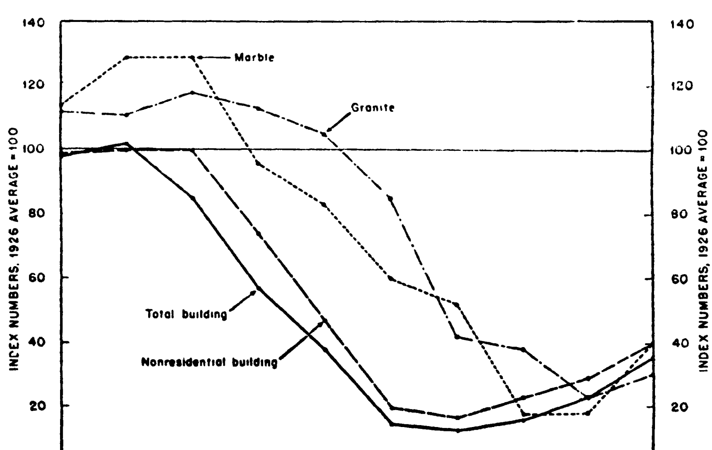


FIGURE 83.—Sales of building marble and granite, compared with total building and nonresidential building, 1927–36. To facilitate comparison, unlike units have been reduced to percentages of the 1927 value. Stone figures are from the Bureau of Mines and include both rough and dressed stone; contracts are from F. W. Dodge Corporation.

Trends in sales of memorial stone.—Sales of memorial granite increased 23 percent and of marble 17 percent in quantity compared with 1935. Prices of both kinds were a little lower than in 1935.

NEW DEVELOPMENTS

Recent changes in tariff rates on granite may influence foreign trade. The tariff on unmanufactured granite—25 cents per cubic foot under the Tariff Act of 1930—was reduced to 20 cents under the reciprocal treaty with Sweden and later to 12½ percent under agreement with Finland. The present rate is equivalent to about 10 percent ad valorem. The duty on manufactured granite which was 60 percent under the Tariff Act of 1930 was reduced to 30 percent under the Finland treaty.

According to an item in the Monumental and Architectural Stone Journal (London), the granite industries of Aberdeen, Scotland, have developed a new and better process for polishing granite, but no details are available.

A new building unit known as "insulated natural stone" is now manufactured in Milwaukee, Wis. Two-inch slabs of Briar Hill (Ohio) sandstone in random lengths and in heights of 2¼, 5, and 7¾ inches are set in the center of a mold, and light weight concrete is filled in on both sides. The sandstone slab is then split in the center, producing two building units, each consisting of 3 inches of light weight concrete faced with 1 inch of stone. The bond between the concrete and stone is firm.

A summary of recent accomplishments with the wire saw in slate, limestone, and sandstone quarries has recently been published.[2]

FOREIGN TRADE [3]

Imports.—Foreign trade in stone is confined chiefly to dimension stone. Imports in 1936 increased 20 percent in value over 1935. The following tables show the value of imports for a 5-year period and the quantities and values by kinds imported in 1936.

Value of stone imported for consumption in the United States, 1932–36

1932	$766,706	1935	$556,584
1933	536,643	1936	665,983
1934	413,301		

Stone imported for consumption in the United States in 1936, by classes

Class	Quantity	Value	Class	Quantity	Value
Marble, breccia, and onyx:			Quartzite ... short tons	50,704	$91,120
In blocks, rough, etc. ... cubic feet	60,784	$256,922	Travertine stone:		
Sawed ... do	172	712	Rough ... cubic feet	48,905	67,125
Slabs or paving tiles ... superficial feet	150,364	58,979	Dressed ... do	12	60
All other manufactures		43,879		48,917	67,185
Mosaic cubes of marble or onyx:			Stone (other):		
Loose ... pounds	5,609	140	Dressed		5,471
		360,632	Rough (monumental or building stone) ... cubic feet	2,229	3,688
Granite:			Rough (other)		7,050
Dressed [1] ... cubic feet	16,227	67,210			
Rough ... do	43,089	63,627			16,209
	59,316	130,837	Grand total		665,983

[1] Also paving blocks valued at $83.

The following table gives imports by countries in 1936. The principal gains were in imports of marble and travertine from Italy. Onyx marble imports from Mexico more than doubled, but imports of this variety from Argentina were smaller in 1936 than in 1935. Granite imports were about the same in both years.

[2] Bowles, Oliver, The Wire Saw as a Tool for Cutting Slate and Building Stone. Amer. Inst. Min. and Met. Eng. Tech. Pub. 741, 1936, 8 pp.

[3] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Stone imported for consumption in the United States in 1936, by classes and countries

Country	Marble, breccia, and onyx			Granite [1]		Other building or monumental stone (value)	Other stone, n. e. s. (value)	Quartzite		Travertine		Total value
	Rough		Manufactures (value)	Cubic feet	Value			Short tons	Value	Cubic feet	Value	
	Cubic feet	Value										
North America:												
Canada	192	$543	$105	9,977	$8,041	$1,855	$6,339	50,680	$90,500			$107,386
Cuba			552			20						572
Mexico	8,799	37,499	82			6						37,587
Total North America	8,991	38,042	739	9,977	8,041	1,881	6,339	50,680	90,500			145,545
South America:												
Argentina	2,837	72,091										72,091
Brazil	141	1,592										1,592
Chile	30	50										50
Dominican Republic							63					63
Total South America	3,008	73,733					63					73,796
Europe:												
Belgium	8,871	31,649	1,047							889	$768	33,464
Czechoslovakia			22,242	30	350							22,592
Denmark			2,476	14	70			24	605			3,151
Finland			270	27,791	72,244							72,514
France	5,465	16,655	7,833	16	48	771						25,307
Germany	821	3,074	1,429	710	2,282	481				12	60	7,326
Greece			13									13
Hungary	176	364										364
Italy	32,414	86,555	61,480			187				48,016	66,357	214,579
Netherlands			218									218
Norway				1,375	2,885		177	(2)	15			3,077
Rumania						2,005						2,005
Spain	185	1,290										1,290
Sweden			67	18,250	39,461		256					39,784
Switzerland			123									123
United Kingdom	453	1,680	3,565	1,137	5,296	314	215					11,070
U. S. S. R.			19			30						49
Yugoslavia			456									456
Total Europe	48,385	141,267	101,238	49,323	122,636	3,788	648	24	620	48,917	67,185	437,382

[1] Also paving blocks valued at $83.

[2] Less than 1 ton.

Stone imported for consumption in the United States in 1936, by classes and countries—Continued

Country	Marble, breccia, and onyx			Granite		Other building or monumental stone (value)	Other stone, n. e. s. (value)	Quartzite		Travertine		Total value
	Rough		Manufactures (value)	Cubic feet	Value			Short tons	Value	Cubic feet	Value	
	Cubic feet	Value										
Asia:												
China			$199	15	$152	$128						$479
Egypt			5									5
Hong Kong						16						16
India (British)			107									107
Iran (Persia)			20									20
Japan			1,402	1	5	813						2,220
Total Asia			1,733	16	157	957						2,847
Africa:												
Algeria	400	$3,880										3,880
Union of South Africa						2,533						2,533
Total Africa	400	3,880				2,533						6,413
Grand total	60,784	256,922	103,710	59,316	130,837	9,159	$7,050	50,704	$91,120	48,917	$67,185	665,983

Exports.—Exports of stone, with which are included cement blocks and other cement manufactures, increased about 2 percent in value in 1936 compared with 1935. The quantity shipped to Cuba shows the most marked increase, but the total export trade is relatively unimportant.

Stone[1] *exported from the United States, 1932–36, by classes*

Year	Marble in blocks, rough or dressed		Other building or monumental stone (including cement building blocks)		Value of other manufactures of stone (including other cement manufactures)	Total value
	Cubic feet	Value	Cubic feet	Value		
1932	30,691	$99,943	73,098	$75,558	$273,755	$449,256
1933	11,585	46,031	29,933	35,588	244,875	326,494
1934	11,475	44,979	43,176	40,311	354,509	439,799
1935	13,466	55,334	86,761	62,185	428,481	546,000
1936	19,815	81,754	38,579	46,902	427,425	556,081

[1] Figures not separately recorded for stone and for cement building blocks, and for stone and for cement manufactures.

Stone[1] *exported from the United States in 1936, by classes and countries*

Country	Marble in blocks, rough or dressed		Other building or monumental stone (including cement building blocks)		Value of other manufactures of stone (including other cement manufactures)	Total value
	Cubic feet	Value	Cubic feet	Value		
Canada	10,161	$46,694	37,999	$45,495	$251,436	$343,625
Cuba	6,978	22,635			13,009	35,644
Newfoundland and Labrador	1,064	6,121			1,756	7,877
United Kingdom	1,096	3,173	143	252	22,465	25,890
Other countries	516	3,131	437	1,155	138,759	143,045
	19,815	81,754	38,579	46,902	427,425	556,081

[1] Figures not separately recorded for stone and for cement building blocks, and for stone and for cement manufactures.

CRUSHED AND BROKEN STONE

Sales of crushed and broken stone in 1936 increased more than 47 percent over 1935. The average price remained the same. All branches of the industry, except stone for glass factories, shared in the advance. The most notable gains were in concrete and road metal, metallurgical stone, refractory stone, agricultural limestone, and riprap.

The following table of salient statistics shows the quantity and value of crushed and broken stone sold during 1935 and 1936 by uses. Detailed data on asphaltic stone and slate granules and flour are given in the chapters of this volume on Asphalt and Slate.

Crushed and broken stone sold or used by producers in the United States, 1935–36, by principal uses

Use	1935			1936 [1]				
	Short tons	Value		Short tons	Value		Percent of change in	
		Total	Average		Total	Average	Tonnage	Average value
Concrete and road metal	49,487,510	$44,888,513	$0.91	72,985,000	$69,032,000	$0.95	+47.5	+4.4
Railroad ballast	5,267,010	4,011,469	.76	6,315,000	4,830,000	.76	+19.9	------
Metallurgical	12,191,660	7,902,717	.65	17,630,000	11,675,000	.66	+44.6	+1.5
Alkali works	4,090,980	2,188,597	.53	4,420,000	2,110,000	.48	+8.0	−9.4
Riprap	4,919,110	4,494,514	.91	10,900,000	7,552,000	.69	+121.6	−24.2
Agricultural	24140,370	2,656,728	1.24	3,411,000	3,840,000	1.13	+59.4	−8.9
Refractory (ganister, mica schist, dolomite, soapstone)	866,320	1,130,232	1.30	1,316,000	1,820,000	1.38	+51.9	+6.2
Asphalt filler	152,040	363,163	2.39	(2)	(2)	------	------	------
Calcium carbide works	287,340	135,844	.47	340,000	170,000	.50	+18.3	+6.4
Sugar factories	460,460	640,375	1.39	541,000	757,000	1.40	+17.5	+.7
Glass factories	250,930	414,027	1.65	238,000	378,000	1.59	−5.2	−3.6
Paper mills	188,090	339,372	1.80	230,000	360,000	1.57	+22.3	−12.8
Other uses	1,396,330	3,141,863	2.25	2,247,000	4,545,000	2.02	+60.9	−10.2
	81,698,150	72,307,414	.89	120,573,000	107,069,000	.89	+47.6	------
Portland cement (including "cement rock") [3] / Natural cement ("cement rock") [3]	19,563,000	(4)	------	28,650,000	(4)	------	+46.4	------
Lime [5]	5,974,000	(4)	------	7,570,000	(4)	------	+26.7	------
Total stone	107,235,000	(4)	------	156,793,000	(4)	------	+46.2	------
Asphaltic stone	314,109	1,449,406	4.61	547,333	2,420,792	4.42	+74.2	−4.1
Slate granules and flour	[6] 226,510	[6] 1,308,345	5.78	289,650	1,646,780	5.69	+27.9	−1.6

[1] Subject to revision.
[2] Figures not yet available.
[3] Value reported as cement in the chapter on Cement.
[4] No value available for stone used in manufacture of cement and lime.
[5] Value reported as lime in the chapter on Lime.
[6] Revised figures.

The following tables show the tonnage and value of stone of all kinds used in concrete and roads and as railroad ballast for a series of years and by States for 1935. Figures by States for 1936 are not yet available.

Concrete and road metal and railroad ballast sold or used by producers in the United States, 1932–36

Year	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1932	48,020,560	$43,651,774	3,974,540	$3,239,991	51,995,100	$46,891,765
1933	40,857,120	35,843,318	4,633,490	3,175,418	45,490,610	39,018,736
1934	55,244,470	52,471,430	5,323,450	3,995,177	60,567,920	56,466.607
1935	49,487,510	44,888,513	5,267,010	4,011,469	54,754,520	48,899,982
1936 [1]	72,985,000	69,032,000	6,315,000	4,830,000	79,300,000	73,862,000

[1] Subject to revision.

Concrete and road metal and railroad ballast sold or used by producers in the United States in 1935, by States

State	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	[1] 91,900	[1] $82,053			[1] 91,900	[1] $82,053
Alaska	(2)	(2)			(2)	(2)
Arizona	165,710	158,027	(2)	(2)	[1] 165,710	[1] 158,027
Arkansas	251,990	266,294	81,020	$81,131	333,010	347,425
California	2,134,860	1,784,415	277,020	148,111	2,411,880	1,932,526
Colorado	684,960	660,735			684,960	660,735
Connecticut	1,326,790	1,256,377	79,630	67,961	1,406,420	1,324,338
Delaware	(2)	(2)			(2)	(2)
Florida	[1] 1,008,550	[1] 777,953	109,640	74,317	[1] 1,118,190	[1] 852,270
Georgia	1,029,250	886,019	(2)	(2)	[1] 1,029,250	[1] 886,019
Hawaii	[1] 180,070	[1] 303,663	(2)	(2)	[1] 180,070	[1] 303,663
Idaho	[1] 648,020	[1] 577,721	(2)	(2)	[1] 648,020	[1] 577,721
Illinois	[1] 2,982,550	[1] 2,114,453	389,650	257,572	[1] 3,372,200	[1] 2,372,025
Indiana	[1] 1,072,020	[1] 853,346	81,280	60,328	[1] 1,153,300	[1] 913,674
Iowa	1,641,290	1,447,369	(2)	(2)	[1] 1,641,290	[1] 1,447,369
Kansas	[1] 1,350,930	[1] 1,346,972	188,250	125,705	[1] 1,539,180	[1] 1,472,677
Kentucky	[1] 1,508,150	[1] 1,404,821	199,040	103,670	[1] 1,707,190	[1] 1,508,491
Louisiana	(2)	(2)	(2)	(2)	(2)	(2)
Maine	43,490	58,197			43,490	58,197
Maryland	385,450	465,436	153,340	193,442	538,790	658,878
Massachusetts	[1] 1,292,840	[1] 1,410,458	44,730	40,426	[1] 1,337,570	[1] 1,450,884
Michigan	891,130	476,667	27,430	19,683	918,560	496,350
Minnesota	243,600	190,527	270	309	243,870	190,836
Missouri	1,462,860	1,501,103	86,890	78,871	1,549,750	1,579,974
Montana	[1] 128,680	[1] 116,274			[1] 128,680	[1] 116,274
Nebraska	71,530	84,303			71,530	84,303
Nevada	[1] 1,036,070	[1] 421,573			[1] 1,036,070	[1] 421,573
New Hampshire	17,580	22,581			17,580	22,581
New Jersey	1,116,550	1,274,045	[1] 38,260	[1] 35,995	[1] 1,154,810	[1] 1,310,040
New Mexico	1,145,490	877,303	(2)	(2)	[1] 1,145,490	[1] 877,303
New York	5,488,300	5,270,520	[1] 685,840	[1] 477,361	[1] 6,174,140	[1] 5,747,881
North Carolina	[1] 885,150	[1] 1,015,838	215,110	212,068	[1] 1,100,260	[1] 1,227,906
North Dakota	(2)	(2)			(2)	(2)
Ohio	3,096,320	2,602,932	387,530	265,757	3,483,850	2,868,689
Oklahoma	550,280	358,178	132,360	77,988	682,640	436,166
Oregon	1,149,140	933,663			1,149,140	933,663
Pennsylvania	[1] 3,223,660	[1] 3,411,021	[1] 323,890	[1] 319,768	[1] 3,547,550	[1] 3,730,789
Puerto Rico	89,470	102,945	5,870	4,184	95,340	107,129
Rhode Island	149,640	188,243			149,640	188,243
South Carolina	275,400	385,065	134,720	124,646	410,120	509,711
South Dakota	[1] 218,160	[1] 266,686	1,430	1,573	[1] 219,590	[1] 268,259
Tennessee	2,543,860	1,880,504	284,540	203,214	2,828,400	2,083,718
Texas	911,570	826,436	224,520	148,707	1,136,090	975,143
Utah	[1] 38,960	[1] 63,155	1,010	743	[1] 39,970	[1] 63,898
Vermont	[1] 61,260	[1] 90,696			[1] 61,260	[1] 90,696
Virginia	1,660,130	1,769,811	524,200	418,833	2,184,330	2,188,644
Washington	[1] 1,825,960	[1] 1,508,511	18,640	14,642	[1] 1,844,600	[1] 1,523,153
West Virginia	717,340	885,656	152,770	92,984	870,110	978,640
Wisconsin	1,754,110	1,428,054	[1] 54,240	[1] 41,069	[1] 1,808,350	[1] 1,469,123
Wyoming	144,840	132,417	19,100	4,623	163,940	137,040
Undistributed	791,650	949,497	344,790	315,788	1,136,440	1,265,285
	49,487,510	44,888,513	5,267,010	4,011,469	54,754,520	48,899,982

[1] To avoid disclosing confidential information certain totals are somewhat incomplete, the figures not included being combined under "Undistributed."
[2] Included under "Undistributed."

Production by kinds.—The following table shows the quantity of each kind of stone employed as aggregate, road stone, or ballast in 1935 and 1936. Of the 1936 totals, about 64 percent was limestone, 13 percent trap rock, 9 percent granite, 5 percent sandstone, and 9 percent miscellaneous stone. The average values per ton at the quarry also are shown in the table.

Concrete and road metal and railroad ballast sold or used by producers in the United States, 1935–36, by kinds

Kind	Concrete and road metal		Railroad ballast		Total		
						Value	
	Short tons	Value	Short tons	Value	Short tons	Total	Average
1935							
Granite	3,953,440	$4,155,337	700,530	$612,550	4,653,970	$4,767,887	$1.02
Basalt and related rocks (trap rock)	7,984,520	7,774,298	572,090	571,124	8,556,610	8,345,422	.98
Limestone	30,151,790	26,354,559	3,623,500	2,525,949	33,775,290	28,880,508	.86
Sandstone	1,657,930	1,806,756	197,850	172,192	1,855,780	1,978,948	1.07
Miscellaneous	5,739,830	4,797,563	173,040	129,654	5,912,870	4,927,217	.83
	49,487,510	44,888,513	5,267,010	4,011,469	54,754,520	48,899,982	
Average value per ton		$0.91		$0.76		$0.89	
1936 [1]							
Granite	6,100,000	6,500,000	470,000	400,000	6,570,000	6,900,000	1.05
Basalt and related rocks (trap rock)	9,705,000	8,870,000	825,000	830,000	10,530,000	9,700,000	.92
Limestone	46,800,000	42,600,000	4,000,000	2,800,000	50,800,000	45,400,000	.89
Sandstone	3,880,000	5,462,000	520,000	400,000	4,400,000	5,862,000	1.33
Miscellaneous	6,500,000	5,600,000	500,000	400,000	7,000,000	6,000,000	.86
	72,985,000	69,032,000	6,315,000	4,830,000	79,300,000	73,862,000	
Average value per ton		$0.95		$0.76		$0.93	

[1] Subject to revision.

Limestone is the most important of all stones used in crushed or broken form because it is regarded as an essential constituent of many products and necessary to the success of many chemical and manufacturing processes. The table on page 1178 shows the principal uses, and those designated as "Other uses" are further subdivided in the following table:

Limestone sold or used by producers in the United States for miscellaneous uses, 1935–36

Use	1935		1936 [1]	
	Short tons	Value	Short tons	Value
Alkali works	4,090,980	$2,188,597	4,420,000	$2,110,000
Calcium carbide works	287,340	135,844	340,000	170,000
Coal-mine dusting	52,660	147,523	(2)	(2)
Filler (not whiting substitute):				
Asphalt	152,040	363,163	(2)	(2)
Fertilizer	39,590	62,847	(2)	(2)
Other	55,850	223,893	(2)	(2)
Filter beds	49,860	52,672	(2)	(2)
Magnesia works (dolomite)	96,810	153,973	125,000	210,000
Mineral food	42,980	190,461	(2)	(2)
Mineral (rock) wool	96,940	81,905	(2)	(2)
Poultry grit	30,290	110,426	(2)	(2)
Road base	157,960	91,810	(2)	(2)
Roofing	9,820	8,919	(2)	(2)
Stucco, terrazzo, and artificial stone	18,810	73,824	(2)	(2)
Whiting substitute [3]	147,910	563,514	(2)	(2)
Other [4]	56,860	82,396	(2)	(2)
Unspecified	72,310	125,243	(2)	(2)
	5,459,010	4,657,010	6,600,000	5,700,000

[1] Subject to revision.
[2] Figures not yet available. Estimate included in total.
[3] Includes stone for filler for calcimine, pigments (paint), polishes, pottery, putty, rubber, targets, wallboard, and uses not specified.
[4] Includes stone for acid neutralization, bird gravel, carbolic acid, carbon dioxide, chemicals (unspecified), dust, dye works, explosives, landscaping, lime burning, mosaics, oil refining, pipe manufacturing, salt refining, spalls, studio snow, and waste rock.

Dolomite (calcium-magnesium carbonate) finds certain special uses, which are covered in the following table.

Dolomite and dolomitic lime sold or used by producers in the United States for specified purposes, 1935-36

	1935	1936 [1]
Dolomite for—		
Basic magnesium carbonate:		
Short tons	96,810	125,000
Value	$153,973	$210,000
Carbon dioxide	[2]	[2]
Refractory stone or dead-burned dolomite:		
Short tons	321,860	400,000
Value	$265,506	$385,000
Dolomitic lime for—		
Refractory (dead-burned dolomite):		
Short tons	455,258	557,000
Value	$3,785,834	$4,963,000
Sulphite pulp:		
Short tons	27,000	28,000
Value	$178,000	$180,000
Total (calculated as raw stone) short tons	1,383,000	1,700,000

[1] Subject to revision.
[2] Bureau of Mines not at liberty to publish figures.

Limestone is used not only in its natural state but is employed extensively as raw material for making cement and lime. These commodities are discussed in separate chapters, but the amount of limestone so used, together with that employed raw, is indicated in the following table. The tonnage of limestone employed for all purposes was nearly 44 percent greater in 1936 than in 1935.

Limestone used for all purposes in the United States, 1935-36, in short tons

Use	1935	1936 [1]
Limestone (as given in this report)	57,492,760	83,048,000
Portland cement (including "cement rock") [2] Natural cement ("cement rock") [2]	19,563,000	28,650,000
Lime [3]	5,974,000	7,570,000
	83,029,760	119,268,000

[1] Subject to revision.
[2] Value reported as cement in the chapter on Cement.
[3] Value reported as lime in the chapter on Lime.

Markets.—Sales of crushed stone for major uses bear a definite relation to the volume of concrete pavement constructed and to sales of portland cement, because stone is used extensively as concrete aggregate. Figure 84 shows this relationship from 1927 to 1936. Highway building, public works projects, and construction in general furnish important markets for crushed stone.

Stone is used extensively in metallurgy. Limestone is employed as a flux in blast furnaces and other metallurgical plants for the purpose of forming a slag to carry off the impurities in ores and metals. Dolomite, ganister, and mica schist are employed as refractories. Therefore, a close relationship exists between sales of stone for these uses and activity in the iron and steel industries as indicated in figure 85.

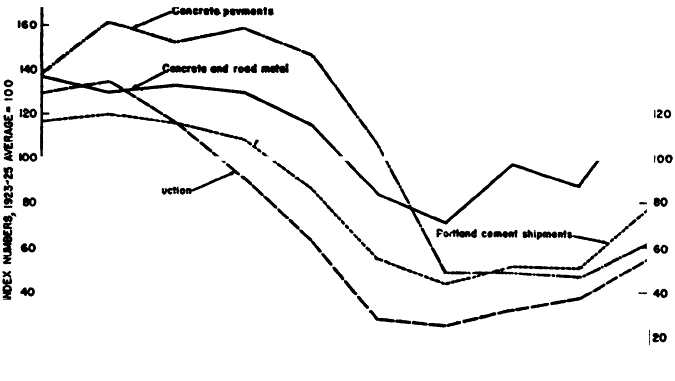


FIGURE 84.—Sales of concrete and road metal (crushed stone) compared with total construction, portland-cement shipments, and contracts for concrete pavements, 1927–36. Data are plotted as index numbers with the 1923–25 average as 100. Figures on cement and stone compiled by the Bureau of Mines, on concrete pavements by the Portland Cement Association, and on construction contracts by the F. W. Dodge Corporation.

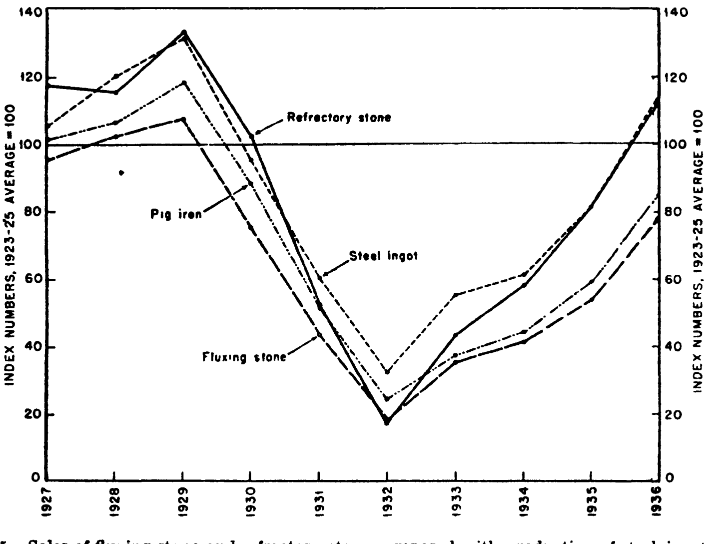


FIGURE 85.—Sales of fluxing stone and refractory stone compared with production of steel ingots and pig iron, 1927–36. All data are plotted as index numbers, with the 1923–25 average as 100. Statistics of steel-ingot and pig-iron production compiled by American Iron and Steel Institute.

Commerical and noncommercial operations.—During recent years Government agencies of various kinds have become important producers of crushed stone. Because of the general interest in such trends, the following table is presented. It may be noted that noncommercial production increased from about 11 percent of the total in 1931 to more than 30 percent in 1935. Statistics for 1936 are not yet available.

Crushed stone sold or used by commercial and noncommercial operators in the United States, 1931–35 [1]

[Figures for "Noncommercial operations" represent tonnages reported by States, counties, municipalities, and other Government agencies, produced either by themselves or by contractors expressly for their consumption, often with publicly owned equipment; they do not include purchases from commercial producers. Figures for "Commercial operations" represent tonnages reported by all other producers]

Year	Commercial operations				Noncommercial operations				Total	
	Short tons	Average value per ton	Percent of change in quantity from preceding year	Percent of total quantity	Short tons	Average value per ton	Percent of change in quantity from preceding year	Percent of total quantity	Short tons	Percent of change in quantity from preceding year
1931	64, 818, 410	(2)	−18. 5	89. 3	7, 806, 000	(2)	+3. 4	10. 7	72, 624, 410	−16. 6
1932	43, 284, 190	(2)	−33. 2	83. 2	8, 710, 910	(2)	+11 6	16 8	51, 995, 100	−28. 4
1933	37, 839, 200	$0. 84	−12. 6	83. 2	7, 651, 410	$0. 95	−12. 2	16. 8	45, 490, 610	−12. 5
1934	43, 259, 180	. 94	+14. 3	71. 4	17, 308, 740	. 91	+126. 2	28. 6	60, 567, 920	+33. 1
1935	38, 090, 660	. 90	−11. 9	69. 6	16, 663, 860	. 87	−3. 7	30. 4	54, 754, 520	−9. 6

[1] Includes stone for concrete and road metal and railroad ballast.
[2] Separate figures for commercial and noncommercial value not available.

Methods of transportation.—The following table shows the quantities of stone conveyed by each of the principal means of transportation during 1934 and 1935.

Crushed stone aggregates (concrete and road metal) shipped by commercial and noncommercial operators in the United States, 1934–35, by methods of transportation [1]

Method of transportation	Commercial operations		Noncommercial operations		Total	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
1934						
Railroad	13, 456, 590	35. 5			13, 456, 590	24. 4
Water	2, 459, 010	6 5			2, 459, 010	4. 4
Truck	20, 934, 840	55. 2	17, 308, 740	100. 0	38, 243, 580	69. 2
Unspecified	1, 085, 290	2. 8			1, 085, 290	2. 0
Total:						
Quantity	37, 935, 730	100. 0	17, 308, 740	100. 0	55, 244, 470	100. 0
Value	$36, 649, 971		$15, 821, 459		$52, 471, 430	
1935						
Railroad	10, 918, 990	33. 3			10, 918, 990	22. 1
Water	3, 179, 040	9. 7			3, 179, 040	6. 4
Truck	18, 409, 920	56. 1	16, 663, 860	100. 0	35, 073, 780	70. 9
Unspecified	315, 700	. 9			315, 700	. 6
Total:						
Quantity	32, 823, 650	100. 0	16, 663, 860	100. 0	49, 487, 510	100. 0
Value	$30, 380, 313		$14, 508, 200		$44, 888, 513	

[1] Exclusive of railroad ballast, virtually all of which is shipped by rail.

SLATE

By Oliver Bowles and M. Schauble

SUMMARY OUTLINE

The slate industry, which suffered a severe decline during recent years, has made a remarkable recovery. The value of sales at the low point of the depression in 1933 was only 21 percent of that in the peak year, 1925. A slow upturn in 1934 was followed by a large increase in 1935, and in 1936 the quantity of slate sold was 37 percent and the value 50 percent greater than in 1935. The value of sales in 1936 was more than twice as great as in 1933. Sales of slate in 1936 totaled 452,400 tons valued at $5,485,208, compared with 330,200 tons valued at $3,649,515 in 1935.

Roofing slate sold in 1936 totaled 366,130 squares valued at $2,607,402, a gain of 65 percent in quantity and 79 percent in value over 1935. The average value per square in 1936 was $7.12, whereas in 1935 it was $6.57. The output of the Pennsylvania district was 235,780 squares valued at $1,603,734 in 1936, a gain of 63 percent in quantity and 82 percent in value over 1935. In the New York-Vermont district 94,760 squares valued at $697,505 were sold, a gain of 63 percent in quantity and 70 percent in value over 1935. In Virginia the gain over 1935 was 92 percent in both quantity and value. Maine showed a substantial gain.

Sales of millstock in 1936 were nearly 40 percent greater than in 1935. Millstock includes all slate used for structural and sanitary purposes, electrical products, blackboards, bulletin boards, school slates, billiard-table tops, vaults, covers, and similar products. A gain in total building construction from 37 percent of the 1923–25 average in 1935 to 55 percent in 1936 led to gains of 44 percent in quantity and 32 percent in value of sales of structural slate. The high level of electrical output in 1935 doubtless accounted for the gain of 30 percent in quantity and 29 percent in value of sales of electrical slate. Production of school slates, which is relatively small, was the only branch of the industry to show a decline in 1936. Public Works Administration funds have made possible the erection of many new schools; therefore the gain of 81 percent in quantity and 66 percent in

value of blackboards sold was to be expected. Sales of vaults and covers show small gains, but slate for flagging, cross walks, and stepping stones, which are becoming increasingly popular, gained more than 50 percent.

The following table giving the principal statistical data for the slate industry during 1935 and 1936 is arranged to permit ready comparison of the 2 years. Granules and flour, which have little connection with the slate industry, appear in the table because they are manufactured from slate, although much of the material so used is derived from deposits that could not be utilized for ordinary slate products. Slate granules and flour are properly crushed-stone products and therefore are included also with other kinds of granules in the chapter of this volume on Stone.

Salient statistics of the slate industry in the United States, 1935–36

	1935 [1]			1936				
	Quantity		Value	Quantity		Value	Percent of change in—	
	Unit of measurement	Approximate equivalent short tons		Unit of measurement	Approximate equivalent short tons		Quantity (unit as reported)	Value
Domestic production (sales by producers):								
Roofing slate	*Squares* 221,630	83,290	$1,456,041	*Squares* 366,130	135,830	$2,607,402	+65.2	+79.1
Millstock:	*Sq. ft.*			*Sq. ft.*				
Electrical slate	353,410	2,660	257,625	460,460	3,840	331,639	+30.3	+28.7
Structural and sanitary slate	698,310	6,540	246,739	1,003,460	7,730	326,047	+43.7	+32.1
Grave vaults and covers	333,750	3,160	73,516	338,870	3,120	73,737	+1.5	+.3
Blackboards and bulletin boards	1,061,360	2,510	260,911	1,919,340	4,960	434,064	+80.8	+66.4
Billiard-table tops	4,720	40	1,855	7,680	60	3,363	+62.7	+81.3
School slates	[2] 542,920	670	9,150	[2] 378,640	390	6,818	−31.0	−25.5
Total millstock	2,994,470	15,580	849,796	4,108,450	20,100	1,175,668	+37.2	+38.3
Flagstones, etc.[3]	614,880	4,820	35,333	949,410	6,820	55,358	+54.4	+56.7
Total slate as dimension stone		103,690	2,341,170		162,750	3,838,426	+57.0	+64.0
Granules and flour		226,510	1,308,345		289,650	1,646,780	+27.9	+25.9
Grand total domestic production		330,200	3,649,515		452,400	5,485,208	+37.0	+50.3
Foreign trade:								
Imports for consumption			5,497			5,548		+.9
Exports:								
Roofing	*Squares* 1,390		11,175	(4)		(4)		
Other dimension slate			[5] 26,098			[5] 56,587		+116.8
Granules and flour		[5] 5,816	[5] 41,083		[5] 9,412	[5] 67,012	+61.8	+63.1

[1] Revised figures.
[2] Reported as pieces: 1935, 1,025,020; 1936, 707,740; square feet approximate.
[3] Includes walkways, stepping stones, and miscellaneous slate.
[4] Figures not available; included in exports of stone.
[5] Collected by the Bureau of Mines from shippers.

SALES

Dimension slate.—The following table shows for recent years sales of dimension slate; that is, all slate sold in blocks or slabs cut to specified sizes and shapes. Such a classification excludes granules and flour.

Slate (other than granules and flour) sold by producers in the United States, 1922–31 (average) and 1932–36

Year	Roofing			Millstock		Other [1]		Total	
	Squares	Approximate equivalent short tons	Value	Approximate short tons	Value	Approximate short tons	Value	Approximate short tons	Value
1922–31 (average)	444,845	157,751	$4,444,978	50,006	$3,454,329	7,485	$87,816	215,242	$7,987,123
1932	144,410	56,140	1,072,255	16,170	810,443	2,180	23,786	74,490	1,906,484
1933	153,170	57,920	967,834	12,060	519,078	3,260	28,951	73,240	1,515,863
1934	137,010	51,640	1,033,164	11,580	581,959	3,350	26,705	66,570	1,641,828
1935 [2]	221,630	83,290	1,456,041	15,580	849,796	4,820	35,333	103,690	2,341,170
1936	336,130	135,830	2,607,402	20,100	1,175,668	6,820	55,358	162,750	3,838,428

[1] Includes flagstones, walkways, stepping stones, and miscellaneous slate.
[2] Revised figures.

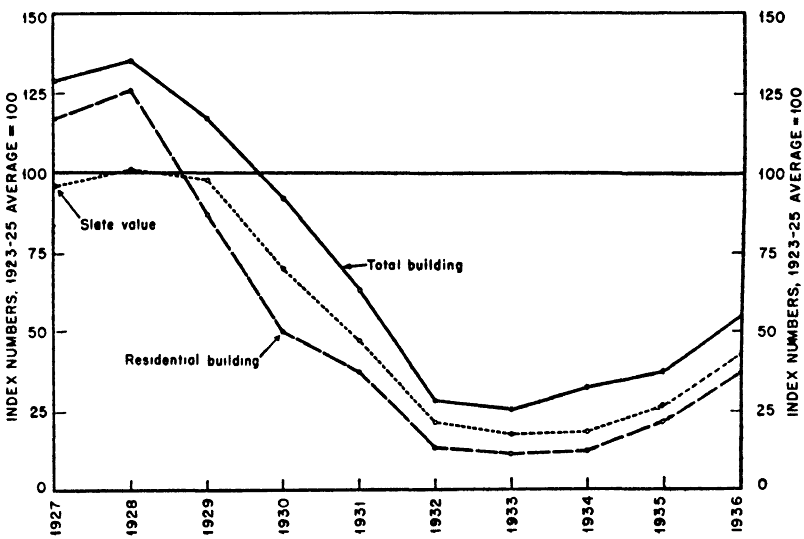


FIGURE 86.—Sales of slate compared with residential building and total building, 1927–36. Statistics of slate compiled by the Bureau of Mines and those for building by the F. W. Dodge Corporation.

Figure 86 compares sales of slate, except granules and flour, from 1927 to 1936 with contracts awarded for residential building and total building during the same period. The figure illustrates the close relation between activity in the slate and construction industries, particularly for the years since 1929. In 1936, slate sales gained almost as rapidly as residential building.

Granules and flour.—The following table shows granules and flour sold by producers from 1932 to 1936:

Crushed slate (granules and flour) sold by producers in the United States, 1932–36

Year	Granules		Flour		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1932	174, 140	$1, 058, 713	35, 610	$139, 103	209, 750	$1, 197, 816
1933	146, 880	1, 024, 917	39, 500	155, 405	186, 380	1, 180, 322
1934	123, 290	902, 078	42, 870	164, 022	166, 160	1, 066, 100
1935 [1]	166, 520	1, 112, 081	59, 990	196, 264	226, 510	1, 308, 345
1936	202, 730	1, 372, 095	86, 920	274, 685	289, 650	1, 646, 780

[1] Revised figures.

Trends in roofing slate.—Residential building is the principal market for roofing slate. There are no statistics available of the roof area of new residential construction, but the F. W. Dodge Corporation publishes data regularly on the floor space represented by contracts awarded. It may be assumed that roof area bears a fairly definite relationship to floor space; therefore the latter may be regarded as a rough index of the area that must be covered with roofing.

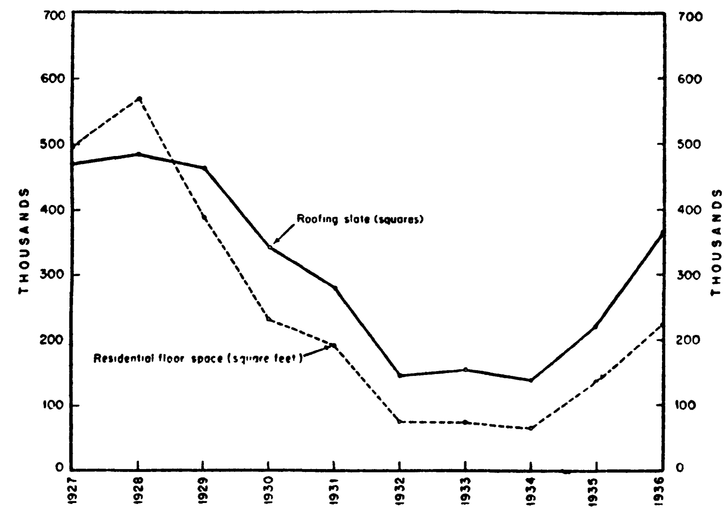


FIGURE 87.—Sales of roofing slate compared with residential floor space, 1927–36. Statistics for slate compiled by the Bureau of Mines and those for floor space by the F. W. Dodge Corporation.

Figure 87 compares sales of roofing slate in squares with residential floor space of new construction from 1927 to 1936. Slate is used for reroofing as well as in new construction, but no figures are available as to the proportion of each. New construction is, however, the principal market, and the chart indicates that slate did not suffer as severe a decline as residential building during the depression. The rapid gain in sales of slate during 1935 and 1936 shows that, compared with past years, slate is maintaining a favorable position in competition with other roofing materials, although it covers only a small percentage of all roofs.

PRICES

Roofing-slate prices, as indicated by sales f. o. b. quarry or mill reported by producers to the Bureau of Mines, gained 55 cents a square—from $6.57 a square in 1935 to $7.12 in 1936. The principal advance was in the Pennsylvania district, where the average sale price was 71 cents a square higher than in 1935; in the Vermont-New York district the increase was 29 cents a square.

Millstock prices were virtually the same in 1936 as in 1935. Electrical slate, structural slate, and blackboards sold at slightly lower and school slates at slightly higher prices.

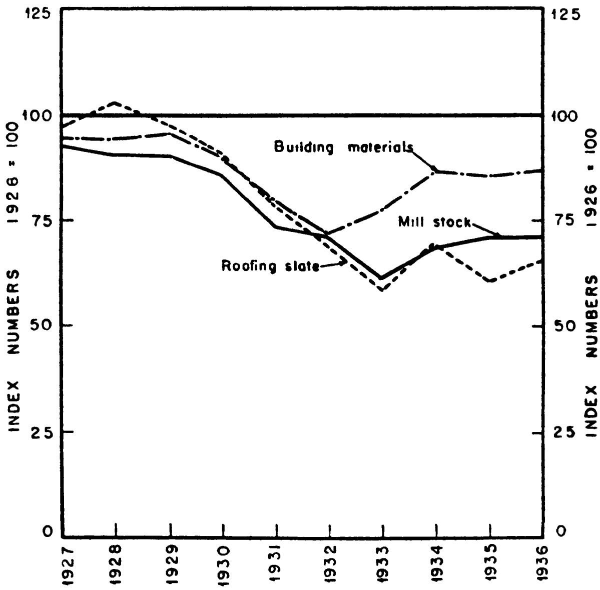


FIGURE 88.—Prices of slate compared with commodity prices of building materials in general, 1927-36. Statistics for slate compiled by the Bureau of Mines; commodity prices by the Bureau of Labor Statistics.

Trends in recent years.—Figure 88 shows graphically the trend of slate prices during the past 10 years compared with prices of building materials in general. Slate prices declined sharply between 1929 and 1932, but not more precipitously than those of other building materials. Since 1932 prices of building materials have recovered greatly; but, as shown on the chart, slate prices have remained at abnormally low levels. Roofing-slate prices recovered somewhat in 1934 but declined again in 1935. However, the substantial upturn in 1936 promises a more prosperous era.

REVIEW BY DISTRICTS

The following table shows sales of slate in 1935 and 1936 by States and uses:

Slate sold by producers in the United States, 1935-36, by States and uses

State	Operators	Roofing: Squares (100 square feet)	Roofing: Value	Millstock: Square feet	Millstock: Value	Other uses [1] (value)	Total value
1935 [2]							
Arkansas	1					(3)	(3)
California	5	40	$320			$42,340	$42,660
Georgia	2					(3)	(3)
Maine	3	3,520	29,408	243,480	$192,391		221,799
Maryland	1					(3)	(3)
New York	14	3,900	32,621	(4)	(4)	250,279	282,900
Pennsylvania [5]	32	144,290	879,209	2,598,910	569,601	351,923	1,800,733
Vermont	54	54,310	378,846	152,080	87,804	363,059	829,709
Virginia	5	15,570	135,637			(3)	(3)
Undistributed [6]						336,077	471,714
Total, 1935	117	221,630	1,456,041	2,994,470	849,796	1,343,678	3,649,515
1936							
Arkansas	1					(3)	(3)
California	5					47,289	47,289
Georgia	2	(3)	(3)			(3)	(3)
Maine	3	5,590	45,382	302,440	240,319		285,701
Maryland	1					(3)	(3)
New York	17	5,300	44,525	(4)	(4)	303,005	347,530
Pennsylvania [5]	31	235,780	1,603,734	3,603,260	824,817	471,462	2,900,013
Tennessee	1	(3)	(3)			(3)	(3)
Vermont	57	89,460	652,980	202,750	110,532	502,096	1,265,608
Virginia	6	29,890	259,921			(3)	(3)
Undistributed [6]		110	860			378,286	639,067
Total, 1936	124	366,130	2,607,402	4,108,450	1,175,668	1,702,138	5,485,208

[1] Flagging and similar products, granules, and flour.
[2] Revised figures.
[3] Included under "Undistributed".
[4] A small amount of millstock included under "Other".
[5] For detailed table for Pennsylvania, see p. 1207.
[6] Includes output of States entered as (3) above.

Maine.—Electrical slate, which is the chief product of the Maine quarries, gained about 31 percent in quantity and 29 percent in value in 1936 compared with 1935. Roofing slate, which is of minor importance, made a substantial gain.

New York-Vermont.—The deposits of New York and Vermont furnish all the colored roofing slate now sold in the United States. Granules and flour, the chief products of the New York quarries, increased 18 percent in value of sales in 1936 compared with 1935. Green, mottled, and purple slates are produced in large quantities in the Vermont quarries. Sales of roofing slate in this State increased 65 percent in quantity and 72 percent in value in 1936 over 1935. Sales of millstock (structural, sanitary, and electrical slate), which is an important product in Vermont, were about one-third greater in 1936 than in 1935. The total value of sales of slate products in Vermont gained nearly 53 percent in 1936.

Peach Bottom district.—The Peach Bottom district situated near Delta, Pa., and Cardiff, Md., is an important source of slate granules and flour. A high-grade, blue-black roofing slate was produced in considerable quantities during past years, but recently production has been very small. In 1936 The Funkhouser Co., a large producer of granules, began production of roofing slate near Delta.

Lehigh district.—The Lehigh district of Pennsylvania furnished roofing, structural, sanitary, and electrical slate, blackboards, school

slates, flagging, granules, and slate flour. It is the most productive slate district in the United States. The following table shows sales in this district in 1935 and 1936 and includes the output of granules and flour in Berks and York Counties.

Slate sold by producers in Pennsylvania, 1935–36, by counties and uses

County	Operators	Roofing slate		Millstock [1]			
				Electrical		Structural and sanitary [2]	
		Squares (100 square feet)	Value	Square feet	Value	Square feet	Value
1935 [4]							
Lehigh	12	16,730	$99,572	46,990	$22,078	62,300	$11,557
Berks, Northampton, and York [5]	20	127,560	779,637	5,000	2,770	875,620	261,280
Total, 1935	32	144,290	879,209	51,990	24,848	937,920	272,837
1936							
Lehigh	9	21,490	142,597	51,450	25,194	39,850	12,203
Berks, Northampton, and York [5]	22	214,290	1,461,137	9,210	5,410	1,197,090	337,765
Total, 1936	31	235,780	1,603,734	60,660	30,604	1,236,940	349,968

County	Millstock [1]					
	Blackboards and bulletin boards		School slates		Other (value) [3]	Total value
	Square feet	Value	Square feet	Value		
1935 [4]						
Lehigh	338,820	$80,448	542,920	$9,150	$100	$222,905
Berks, Northampton, and York [5]	722,540	180,463			353,678	1,577,828
Total, 1935	1,061,360	260,911	542,920	9,150	353,778	1,800,733
1936						
Lehigh	509,820	108,058	378,640	6,818		294,870
Berks, Northampton, and York [5]	1,409,520	326,006			474,825	2,605,143
Total, 1936	1,919,340	434,064	378,640	6,818	474,825	2,900,013

[1] Exclusive of billiard-table material, value for which is included under "Other."
[2] Includes slate for grave covers and vaults.
[3] Includes billiard-table material, as follows: 1935, 4,720 square feet valued at $1,855; 1936, 7,680 square feet valued at $3,363.
[4] Revised figures.
[5] Berks and York Counties produced roofing granules and flour only.

Both hard and soft slate are produced. The former is used almost exclusively for roofing and the latter for both roofing and millstock. The output of all products of the industry in this district showed decisive gains except that of school slates, which decreased 30 percent in quantity and 25 percent in value compared with 1935. Sales of roofing slate increased 63 percent in quantity and 82 percent in value; electrical slate, 17 percent in quantity and 23 percent in value; structural and sanitary slate, 32 percent in quantity and 28 percent in value; and blackboards, 81 percent in quantity and 66 percent in value. Granules and flour sales gained 33 percent in value. The value of total sales of slate products advanced 61 percent in 1936 over 1935.

Virginia.—Principal production is in Buckingham County, which produces roofing slate almost exclusively. Sales of roofing slate in

1936 increased about 92 percent in both quantity and value compared with 1935.

Other districts.—Georgia and Tennessee reported production of granules and a small quantity of roofing slate. The output in California consists chiefly of granules.

NEW DEVELOPMENTS

It was reported in June 1936 that a slate quarry at Madoc, Ontario, Canada, which was operated about 50 years ago, was about to be reopened.

Tests conducted in England indicate that certain slates when calcined will expand greatly to give a product that serves well as a lightweight aggregate for concrete. This suggests a possible profitable utilization of waste slate in the United States.

FOREIGN TRADE [1]

Imports.—The value of slate imported for consumption in the United States in 1936 was slightly higher than in 1935 but only about 6 percent of the value of imports in 1929. The following table shows value of imports from 1931 to 1936.

Value of slate imported for consumption in the United States, 1931–36

1931	$46,581	1934	$12,639
1932	17,317	1935	5,497
1933	9,688	1936	5,548

The following table shows the value of imports in 1935 and 1936 by countries.

Value of slate (manufactured) imported into the United States, 1935–36, by countries

Country	1935	1936	Country	1935	1936
Canada	$2,033	$1,074	Japan	$360	$195
China	6		United Kingdom	31	271
Czechoslovakia	2,317	1,904			
Hong Kong	83	21		5,497	5,548
Italy	667	2,083			

Exports.—The following table shows exports of roofing slate from 1932 to 1936. Exports of roofing slate were included with exports of stone in 1936, therefore a separate figure cannot be given.

Roofing slate exported from the United States, 1932–36

Year	Number of squares	Value	Year	Number of squares	Value
1932	1,792	$12,215	1935	1,390	$11,175
1933	1,155	7,244	1936	(1)	(1)
1934	1,128	9,851			

[1] Figures not available; included in exports of stone.

[1] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

The following table shows exports of slate other than roofing slate from 1934 to 1936. Exports of all products except school slates show large increases in 1936 compared with 1935. School slates declined a little in quantity but increased in value. The value of all slate exports was 84 percent higher in 1936 than in 1935.

Slate other than roofing exported from the United States, 1934–36, by uses [1]

Use	1934		1935		1936	
	Quantity	Value	Quantity	Value	Quantity	Value
School slates ... cases [2]	3,686	$25,028	2,773	$18,140	2,651	$20,204
Electrical slate ... square feet	114	205	10	10	5,528	4,449
Blackboards ... do	37,342	10,425	25,578	7,160	53,486	15,502
Billiard tables ... do	489	230	1,146	518	26,729	10,601
Structural [3] ... do	2,985	1,225	614	270	25,592	5,831
Slate granules and flour ... short tons	6,399	43,414	5,816	41,083	9,412	67,012
	----------	80,527	----------	67,181	----------	123,599

[1] Collected by Bureau of Mines from shippers of products named.
[2] Cases weigh 130 to 165 pounds each; average is 135 pounds; cases contain from 8 to 18 dozen slates, depending on size. Sizes run from 5 by 7 to 8 by 12 inches (inside frame).
[3] A small amount of slate for floors and walkways included under "Structural."

SAND AND GRAVEL [1]

By H. H. Hughes and M. A. Cornthwaite

SUMMARY OUTLINE

Greater activity in building and highway construction in 1936 resulted in increased business for commercial sand and gravel producers, compared with 1935. With the continuation of extensive secondary road programs in many States, partly with work-relief funds, the output of noncommercial operations likewise increased. Available data on consuming markets for sand and gravel and incomplete returns from producers indicate that the total output of commercial and noncommercial plants in 1936 was 172,660,000 short tons valued at $88,747,000. This apparent increase of 39 percent in tonnage and 43 percent in value from 1935 continued the upswing that began in 1934 following a sharp decline from 1929 to 1933. (See fig. 89.)

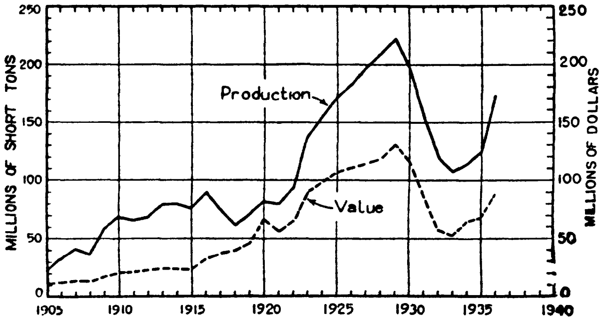


FIGURE 89.—Principal trends in the sand and gravel industry, 1905–36.

Sales of sand and gravel for all important uses increased in 1936 compared with 1935. Building sand and gravel sales, in particular, were much higher than in 1935, and sales for paving and railroad ballast also advanced sharply. The demand for glass, molding, and other industrial sands reflected the marked acceleration in general business conditions, the range of increase being 1 to 34 percent. The total output of commercial sand and gravel operations in 1936 was 119,660,000

[1] Data for 1936 are preliminary; detailed statistics with final revisions will be released later.

short tons compared with 84,607,471 tons in 1935, an increase of 41 percent.

Partial returns from States, counties, municipalities, and other local government agencies indicate that the production of sand and gravel at noncommercial plants increased to about 53,000,000 tons in 1936, 35 percent above 1935. Prices were virtually unchanged from 1935.

Salient statistics of the sand and gravel industry in 1935 and preliminary figures for 1936 are summarized in the following table:

Sand and gravel sold or used by producers in the United States, 1935–36, by commercial and noncommercial operations and by uses

	1935			1936 [1]				
	Short tons	Value		Short tons	Value		Percent of change in—	
		Total	Average		Total	Average	Tonnage	Average value
COMMERCIAL OPERATIONS								
Sand:								
Glass	2,125,761	$3,735,343	$1.76	2,440,000	$4,150,000	$1.70	+15	−3
Molding	2,980,879	2,915,173	.98	4,000,000	4,160,000	1.04	+34	+6
Building	15,996,867	8,547,659	.53	27,500,000	14,600,000	.53	+72	
Paving	11,370,611	6,403,215	.56	14,800,000	7,800,000	.53	+30	−5
Grinding and polishing	816,540	1,198,653	1.47	960,000	1,320,000	1.38	+18	−6
Fire or furnace	172,847	204,477	1.18	210,000	252,000	1.20	+21	+2
Engine	1,389,877	881,910	.63	1,500,000	975,000	.65	+8	+3
Filter	49,301	93,479	1.90	50,000	110,000	2.20	+1	+16
Railroad ballast [2]	997,499	256,922	.26	1,250,000	280,000	.22	+25	−15
Other	1,875,808	860,557	.46	1,250,000	880,000	.70	−33	+52
Total sand	37,775,990	25,097,388	.66	53,960,000	34,527,000	.64	+43	−3
Gravel:								
Building	14,819,051	9,980,363	.67	26,000,000	18,200,000	.70	+75	+4
Paving	19,093,195	12,027,867	.63	27,500,000	16,500,000	.60	+44	−5
Railroad ballast [3]	7,546,489	2,143,275	.28	11,200,000	3,000,000	.27	+48	−4
Other	5,372,746	1,995,083	.37	1,000,000	520,000	.52	−81	+41
Total gravel	46,831,481	26,146,588	.56	65,700,000	38,220,000	.58	+40	+4
Total sand and gravel	84,607,471	51,243,976	.61	119,660,000	72,747,000	.61	+41	
NONCOMMERCIAL OPERATIONS [4]								
Sand:								
Building	543,457	272,053	.50	(5)	(5)	(5)		
Paving	2,114,112	497,781	.24	(5)	(5)	(5)		
Total sand	2,657,569	769,834	.29	(5)	(5)	(5)		
Gravel:								
Building	822,525	352,346	.43	(5)	(5)	(5)		
Paving	35,836,358	9,611,223	.27	(5)	(5)	(5)		
Total gravel	36,658,883	9,963,569	.27	(5)	(5)	(5)		
Total sand and gravel	39,316,452	10,733,403	.27	53,000,000	16,000,000	.30	+35	+11
COMMERCIAL AND NONCOMMERCIAL OPERATIONS								
Sand	40,433,559	25,867,222	.64	(5)	(5)	(5)		
Gravel	83,490,364	36,110,157	.43	(5)	(5)	(5)		
Grand total	123,923,923	61,977,379	.50	172,660,000	88,747,000	.51	+39	+2

[1] Subject to revision.

[2] Includes some sand used for fills and similar purposes. The quantity of sand reported as used exclusively for railroad ballast in 1935 was 870,600 tons valued at $237,059; break-down for 1936 not available. The figures include sand produced by railroads for their own use as follows—1935: Ballast, 173,408 tons valued at $21,003, and fills and similar purposes, 126,889 tons valued at $19,863; 1936: Break-down not available.

[3] Includes some gravel used for fills and similar purposes. The quantity of gravel reported as used exclusively for railroad ballast in 1935 was 7,272,186 tons valued at $2,107,184; break-down for 1936 not available. The figures include gravel produced by railroads for their own use as follows—1935: Ballast, 3,280,094 tons valued at $471,108, and fills and similar purposes, 274,303 tons valued at $36,091; 1936: Break-down not available.

[4] By States, counties, municipalities and other government agencies, directly or under lease.

[5] Not available.

PRODUCTION

Although preliminary figures are available to indicate the approximate output of the sand and gravel industry in 1936, complete details by States and by uses could not be compiled in time for inclusion in the current volume of the Minerals Yearbook. These detailed data for 1936, however, will be released in temporary form as soon as the canvass is completed and, to maintain the historical continuity of the statistics in the permanent record, will be included in the next volume of the Yearbook. Similarly, complete details for 1935 are given in the following tables:

Sand and gravel sold or used by producers in the United States, 1931-36

Year	Sand		Gravel (including railroad ballast)		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1931	64, 492, 826	$36, 696, 746	88, 986, 218	$49, 583, 574	153, 479, 044	$86, 280, 320
1932	42, 794, 875	22, 497, 074	77, 243, 022	35, 025, 002	120, 037, 897	57, 522, 076
1933	33, 160, 846	19, 676, 672	74, 594, 503	33, 396, 238	107, 755, 349	53, 072, 910
1934	38, 400, 090	24, 881, 071	78, 211, 599	36, 366, 102	116, 611, 689	61, 247, 173
1935	40, 433, 559	25, 867, 222	83, 490, 364	36, 110, 157	123, 923, 923	61, 977, 379
1936 [1]	(2)	(2)	(2)	(2)	172, 660, 000	88, 747, 000

[1] Subject to revision. [2] Data not yet available.

Sand and gravel sold or used by commercial and noncommercial producers in the United States in 1935, by States and uses

State	Sand															
	Glass		Molding		Building [1]		Paving [1]		Grinding and polishing		Fire or furnace		Engine		Filter	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama					135,387	$67,133	87,821	$39,968	(2)	(2)	(2)	(2)	(2)	(2)		
Alaska																
Arizona					(2)	(2)	(2)	(2)					3,333	$1,547		
Arkansas	(2)	(2)	(2)	(2)	100,595	61,437	107,749	57,422					(2)	(2)	(2)	(2)
California	(2)	(2)	24,339	$54,710	1,783,462	961,452	1,099,389	583,785	11,274	$29,893	(2)	(2)	6,905	4,229	(2)	(2)
Colorado					111,258	66,949	40,567	6,495	(2)	(2)			(2)	(2)		
Connecticut					111,269	72,475	85,429	48,574	(2)	(2)						
Delaware			(2)	(2)	6,293	4,391	(2)	(2)	(2)	(2)			32,200	11,200	(2)	(2)
Florida					(2)	(2)	(2)	(2)					1,170	133		
Georgia	(2)	(2)			104,577	64,202	187,510	102,121	5,620	8,230			(2)	(2)	(2)	(2)
Hawaii																
Idaho					12,952	5,437	(2)	(2)					30	15		
Illinois	470,546	$554,322	465,871	439,194	1,158,015	454,427	901,428	387,925	115,293	367,302	(2)	(2)	45,809	25,820	(2)	(2)
Indiana			158,890	118,694	419,610	212,308	881,799	389,448			(2)	(2)	85,265	22,125		
Iowa			(2)	(2)	368,416	176,530	463,189	132,652	(2)	(2)			27,234	11,425	(2)	(2)
Kansas			(2)	(2)	433,684	214,721	350,045	146,779	769	343			63,152	34,929	(2)	(2)
Kentucky	(2)	(2)	6,010	10,126	51,875	40,859	223,527	148,859					(2)	(2)		
Louisiana					114,409	44,940	188,531	96,653					9,417	3,068		
Maine					21,791	11,180	11,145	7,624								
Maryland					198,904	153,896	538,474	430,523					(2)	(2)		
Massachusetts			(2)	(2)	465,273	249,099	241,522	83,792					(2)	(2)	(2)	(2)
Michigan	(2)	(2)	920,616	317,332	428,831	130,326	625,159	233,251	132,342	79,011	(2)	(2)	1,482	1,507		
Minnesota			(2)	(2)	669,375	222,446	147,344	50,293	854	2,135			6,120	979	1,118	$2,795
Mississippi					54,423	18,772	66,677	18,972					3,459	965		
Missouri	175,587	251,779	18,550	12,951	587,979	313,633	255,807	198,307	(2)	(2)			19,469	14,882		
Montana					262,215	123,964	(2)	(2)					(2)	(2)	2,100	3,000
Nebraska			2,695	1,670	196,847	76,011	151,226	60,157	550	192			100,142	30,432	400	1,200
Nevada	18,070	43,632	670	1,039	24,136	19,994	1,528	791								
New Hampshire					(2)	(2)	316,961	23,633								
New Jersey	150,715	242,326	383,772	501,557	803,058	411,768	415,805	242,265	14,988	39,534	17,596	$23,130	(2)	(2)	(2)	(2)
New Mexico					30,406	26,358	(2)	(2)					(2)	(2)		
New York	(2)	(2)	274,994	445,478	2,999,829	1,510,990	1,414,282	768,964	(2)	(2)			30,923	17,498		
North Carolina					(2)	(2)	498,850	110,198					(2)	(2)	(2)	(2)
North Dakota					(2)	(2)	(2)	(2)								
Ohio	(2)	(2)	319,627	496,766	902,705	619,013	778,976	424,266	(2)	(2)	(2)	(2)	58,249	42,157	14,272	12,722

Oklahoma	(2)	(2)	----	----	139, 511	76, 114	82, 124	34, 213	----	----	----	----	(2)	(2)	823	2, 973
Oregon	----	----	----	----	129, 190	82, 570	38, 642	16, 650	----	----	----	----	(2)	(2)	----	----
Pennsylvania	440, 394	747, 892	108, 656	309, 531	881, 739	685, 755	727, 727	596, 124	325, 997	389, 183	61, 147	84, 233	229, 461	253, 353	----	----
Rhode Island	----	----	(2)	(2)	(2)	(2)	59, 461	8, 423	----	----	----	----	----	----	(2)	(2)
South Carolina	(2)	(2)	----	----	(2)	(2)	63, 478	34, 745	(2)	(2)	----	----	(2)	(2)	----	----
South Dakota	----	----	----	----	103, 800	42, 640	112, 258	29, 019	----	----	----	----	(2)	(2)	----	----
Tennessee	----	----	(2)	(2)	224, 289	154, 069	252, 756	202, 546	(2)	(2)	(2)	(2)	42, 712	29, 488	----	----
Texas	(2)	(2)	(2)	(2)	567, 497	417, 367	584, 576	371, 324	(2)	(2)	(2)	(2)	28, 904	15, 605	----	----
Utah	----	----	(2)	(2)	93, 351	51, 239	60, 843	50, 476	----	----	----	----	(2)	(2)	109	109
Vermont	----	----	----	----	4, 399	3, 044	2, 705	2, 363	(2)	(2)	----	----	(2)	(2)	----	----
Virginia	(2)	(2)	4, 772	4, 656	312, 902	201, 522	421, 494	263, 943	----	----	----	----	63, 912	25, 645	----	----
Washington	----	----	----	----	336, 503	178, 881	247, 051	111, 775	----	----	----	----	23, 535	4, 839	----	----
West Virginia	(2)	(2)	(2)	(2)	368, 213	233, 694	144, 485	117, 421	(2)	(2)	(2)	(2)	218, 886	176, 900	----	----
Wisconsin	----	----	62, 944	43, 524	469, 733	184, 233	389, 675	153, 656	34, 452	57, 902	----	----	28, 096	7, 755	(2)	(2)
Wyoming	----	----	----	----	23, 137	14, 732	2, 364	2, 050	----	----	----	----	----	----	----	----
Undistributed [3]	870, 449	1, 895, 392	138, 473	157, 942	328, 486	159, 141	214, 344	112, 551	174, 401	224, 928	94, 104	97, 114	260, 012	145, 324	30, 479	70, 680
	2, 125, 761	3, 735, 343	2, 980, 879	2, 915, 173	16, 540, 324	8, 819, 712	13, 484, 723	6, 900, 996	816, 540	1, 198, 653	172, 847	204, 477	1, 389, 877	881, 910	49, 301	93, 479
Average value	----	1.75	----	0.98	----	0.53	----	0.51	----	1.47	----	1.18	----	0.63	----	1.90

See footnotes at end of table

Sand and gravel sold or used by commercial and noncommercial producers in the United States in 1935, by States and uses—Continued

State	Sand—Continued				Gravel									
	Railroad ballast [4]		Other		Building [1]		Paving [1]		Railroad ballast [5]		Other [6]		Total sand and gravel [1]	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama					91,637	$58,105	174,024	$54,297	(2)	(2)	(2)	(2)	572,953	$241,947
Alaska							(2)	(2)					(2)	(2)
Arizona					(2)	(2)	(2)	(2)	(2)	(2)			(2)	(2)
Arkansas	(2)	(2)	(2)	(2)	54,753	48,957	741,376	206,959	102,839	$49,778			1,189,420	512,010
California	46,651	$4,008	26,285	$12,648	1,523,921	976,590	2,210,298	1,214,844	89,729	17,909	3,915	$3,333	6,890,719	4,119,402
Colorado	(2)	(2)	(2)	(2)	184,869	123,597	862,380	298,198			(2)	(2)	1,266,073	528,030
Connecticut	(2)	(2)			191,195	68,309	47,960	42,129	(2)	(2)			448,360	239,863
Delaware			(2)	(2)	(2)	(2)							50,860	28,671
Florida					47,883	45,750	17,532	14,026					385,711	233,029
Georgia			(2)	(2)	(2)	(2)	24,618	24,248					364,507	240,565
Hawaii					(2)	(2)							(2)	(2)
Idaho	(2)	(2)			26,358	12,661	846,113	549,290	27,450	2,956			972,743	584,953
Illinois	411,333	118,811	133,689	944,35	1,376,076	613,573	2,312,064	908,718	822,589	250,416	130,864	46,983	8,354,473	4,276,342
Indiana	18,584	4,179	(2)	(2)	408,002	298,481	1,465,247	807,577	922,204	409,065	36,953	12,566	4,450,885	2,293,749
Iowa	15,249	4,538	57,369	29,680	278,041	223,840	4,238,618	1,041,962	(2)	(2)	(2)	(2)	5,732,742	1,756,851
Kansas	660	166	20,397	6,535	103,823	73,571	593,434	182,856			(2)	(2)	1,570,975	666,529
Kentucky					36,539	30,497	428,129	142,229	21,568	8,627			856,381	550,569
Louisiana	(2)	(2)	(2)	(2)	171,333	128,667	695,346	521,654	131,546	52,820			1,359,567	869,140
Maine			(2)	(2)	37,801	25,412	2,087,710	167,091	(2)	(2)	(2)	(2)	2,326,814	256,365
Maryland			(2)	(2)	244,690	267,133	477,418	557,552					1,483,386	1,434,761
Massachusetts	(2)	(2)	13,684	9,530	339,539	252,939	599,776	149,965	(2)	(2)	1,002	825	1,876,660	831,103
Michigan	(2)	(2)	17,580	5,585	474,499	228,606	3,574,972	1,461,239	255,085	105,764	23,108	7,232	6,591,748	2,794,031
Minnesota	22,175	4,190	(2)	(2)	570,453	562,709	4,179,031	1,213,850	511,437	81,202	19,290	14,079	6,166,064	2,169,332
Mississippi	(2)	(2)	(2)	(2)	164,496	105,914	484,612	196,873	50,455	10,358	(2)	(2)	924,406	381,799
Missouri	(2)	(2)	21,884	5,996	327,350	146,922	1,467,842	794,852	138,248	73,116	(2)	(2)	3,109,104	1,889,787
Montana	29,550	12,652			663,683	300,430	2,075,177	738,338	702,827	122,361	(2)	(2)	7,692,457	2,830,095
Nebraska	24,105	5,701	(2)	(2)	604,228	278,021	873,987	385,355	(2)	(2)	(2)	(2)	2,028,637	854,412
Nevada			370	619	41,255	36,226	1,238,052	556,101	106,650	6,817	3,347	2,575	1,434,078	667,794
New Hampshire					(2)	(2)	1,334,413	120,836	108	12	(2)	(2)	1,675,569	153,704
New Jersey			27,073	12,949	440,356	323,388	251,542	97,424	(2)	(2)	8,892	17,240	2,573,732	1,960,986
New Mexico					63,240	55,787	28,641	1,600	(2)	(2)			156,081	104,113
New York	(2)	(2)	1,130,132	332,134	1,863,295	1,282,582	1,954,037	939,721	3,248	639	(2)	(2)	10,774,096	5,617,572
North Carolina			(2)	(2)	(2)	(2)	211,427	121,397	(2)	(2)	(2)	(2)	815,580	310,291
North Dakota					34,001	16,439	791,851	21,689	76,046	7,589	(2)	(2)	934,387	53,810
Ohio	39,455	11,960	28,767	33,455	658,733	474,837	1,535,065	812,531	476,704	221,084	18,148	14,344	5,045,695	3,745,868
Oklahoma	61	30	1,743	901	36,684	23,409	882,370	158,530			40	108	1,178,262	335,373
Oregon	945	236	(2)	(2)	197,402	112,104	707,698	402,036	65,358	24,555			1,153,885	642,186

Pennsylvania	-------	-------	123,126	140,556	729,937	607,808	740,333	575,922	(2)	(2)	(2)	(2)	4,480,079	4,407,721
Rhode Island	(2)	(2)	-------	-------	(2)	(2)	257,375	49,551	-------	-------	-------	-------	376,320	112,033
South Carolina	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	-------	-------	-------	-------	145,934	107,476
South Dakota	(2)	(2)	(2)	(2)	58,594	16,406	3,799,167	681,815	78,551	16,564	-------	-------	4,178,035	794,276
Tennessee	-------	-------	6,131	8,197	332,495	235,939	518,130	329,629	198,603	71,527	(2)	(2)	1,611,642	1,076,724
Texas	109,870	25,213	11,227	1,907	680,178	593,900	2,303,839	1,204,967	595,623	195,093	6,514	3,740	4,895,362	2,839,513
Utah	-------	-------	17,740	3,476	123,516	66,850	1,408,163	842,185	86,839	8,569	-------	-------	1,811,105	1,030,687
Vermont	-------	-------	-------	-------	1,620	1,571	239,437	114,828	-------	-------	-------	-------	284,947	137,216
Virginia	960	605	41,597	29,044	447,568	430,601	508,849	413,315	31,765	19,476	(2)	(2)	1,866,686	1,438,282
Washington	1,049	148	4,612	3,711	680,363	334,086	1,675,593	703,861	316,424	21,667	14,442	7,195	3,299,572	1,366,163
West Virginia	(2)	(2)	(2)	(2)	565,475	361,938	365,232	271,691	(2)	(2)	-------	-------	2,065,844	1,897,841
Wisconsin	71,902	17,821	(2)	(2)	604,107	343,029	2,681,645	1,147,299	401,155	82,609	19,257	6,965	4,776,673	2,066,516
Wyoming	-------	-------	-------	-------	41,545	29,223	967,707	365,152	584,310	65,302	-------	-------	1,619,063	476,459
Undistributed [3]	204,950	46,664	192,402	129,199	120,043	115,902	51,323	32,908	749,128	217,400	5,086,974	1,857,898	105,651	51,440
	997,499	256,922	1,875,808	860,557	15,641,576	10,332,709	54,929,553	21,639,090	7,516,489	2,143,275	5,372,746	1,995,083	123,923,923	61,977,379
Average value	-------	0.26	-------	0.46	-------	0.66	-------	0.39	-------	0.28	-------	0.37	-------	0.50

[1] Includes noncommercial production.
[2] Included under "Undistributed."
[3] Includes items entered as "2."
[4] Includes some sand used for fills and similar purposes. The quantity of sand reported as used exclusively for ballast was 870,600 tons valued at $237,059. The figures include sand produced by railroads for their own use as follows. Ballast, 173,408 tons valued at $21,003; fills and similar purposes, 126,889 tons valued at $19,863.
[5] Includes some gravel used for fills and similar purposes. The quantity of gravel reported as used exclusively for ballast was 7,272,186 tons valued at $2,107,184. The figures include gravel produced by railroads for their own use as follows: Ballast, 3,280,094 tons valued at $471,108; fills and similar purposes, 274,303 tons valued at $36,091.
[6] May include some gravel used by railroads for fills and miscellaneous purposes.

Noncommercial operations.—Segregation of sand and gravel reported by States, counties, municipalities, and other local Government agencies was begun during the 1932 canvass, when it was found that these noncommercial operations were producing an increasing percentage of the total annual output. Noncommercial production increased from 5 percent of the total production in 1928 to 39 percent in 1933; and, although the tonnage remained about the same in 1934 and 1935, because of increased commercial production it comprised only 35 and 32 percent, respectively, of the total. Preliminary data indicate an increase of roughly 35 percent in 1936, the estimated quantity of 53,000,000 tons comprising 31 percent of the total sand and gravel accounted for. (See fig. 90.)

The average value of all noncommercial material reported in 1935 was $0.27 a ton, whereas the indicated average in 1936 was $0.30. Of the 1935 total, 22,011,231 tons valued at $0.22 a ton was produced directly by construction or maintenance crews of States, counties, municipalities, and other local Government agencies, while 17,305,221 tons valued at $0.34 a ton was produced by contractors expressly for the use of such agencies. State highway departments accounted for 56 percent of the total output; counties, 40 percent; municipalities, 3 percent; and other agencies, 1 percent.

Sand and gravel sold or used by producers in the United States, 1932–36, by commercial and noncommercial operations

[Figures for "noncommercial operations" represent tonnages reported by States, counties, municipalities, and other Government agencies, produced either by themselves or by contractors expressly for their consumption, often with publicly owned equipment; they do not include purchases from commercial producers. Figures for "commercial operations" represent tonnages reported by all other producers including relatively small amounts of railroad ballast and fill produced directly by railroad carriers for their own use]

Year	Commercial operations		Noncommercial operations [1]		Total accounted for	
	Short tons	Percent of change from preceding year	Short tons	Percent of change from preceding year	Short tons	Percent of change from preceding year
1932	85,289,076	−33.9	34,748,821	+41.6	120,037,897	−21.8
1933	66,106,472	−22.5	41,648,877	+19.9	107,755,349	−10.2
1934	75,322,909	+13.9	[2] 41,288,780	−.9	116,611,689	+8.2
1935	84,607,471	+12.3	[3] 39,316,452	−4.8	123,923,923	+6.3
1936 [4]	119,660,000	+41.4	53,000,000	+34.8	172,660,000	+39.3

[1] Part of the apparently large increase in noncommercial production is due to more nearly complete reports in the later years.

[2] Includes 20,314,296 tons valued at $0.22 a ton produced directly by construction and maintenance crews of States, counties, municipalities, and other Government agencies and 20,974,484 tons valued at $0.40 a ton produced by contractors expressly for the use of such agencies. Various agencies reported production as follows: States, 27,950,916 tons valued at $0.35 per ton; counties, 11,382,718 tons at $0.18; municipalities 631,461 tons at $0.23; and others, 1,323,685 tons at $0.67.

[3] Includes 22,011,231 tons valued at $0.22 a ton produced directly by construction and maintenance crews of States, counties, municipalities, and other Government agencies and 17,305,221 tons valued at $0.34 a ton produced by contractors expressly for the use of such agencies. Various agencies reported production as follows: States, 22,016,880 tons valued at $0.32 per ton; counties, 15,965,458 tons at $0.20; municipalities, 1,027,130 tons at $0.32; and others, 306,984 tons at $0.73.

[4] Subject to revision.

Commercial production of sand and gravel for building and paving is centered largely in the Mid-Atlantic and Mid-Western States, with California, Texas, and Washington as the large producers elsewhere. Noncommercial production, on the other hand, looms large in New England, North Central, and Rocky Mountain States. (See fig. 91.)

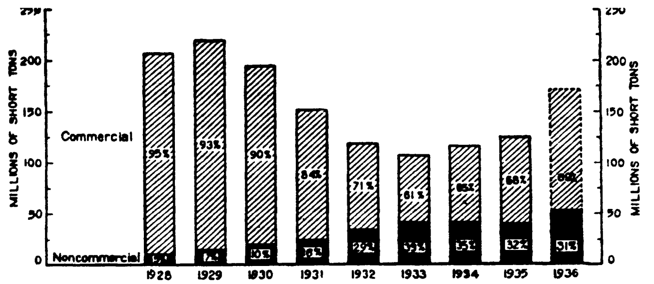


FIGURE 90.—Sand and gravel sold or used in the United States by commercial and noncommercial producers, 1928–36. Figures for 1936 are subject to revision.

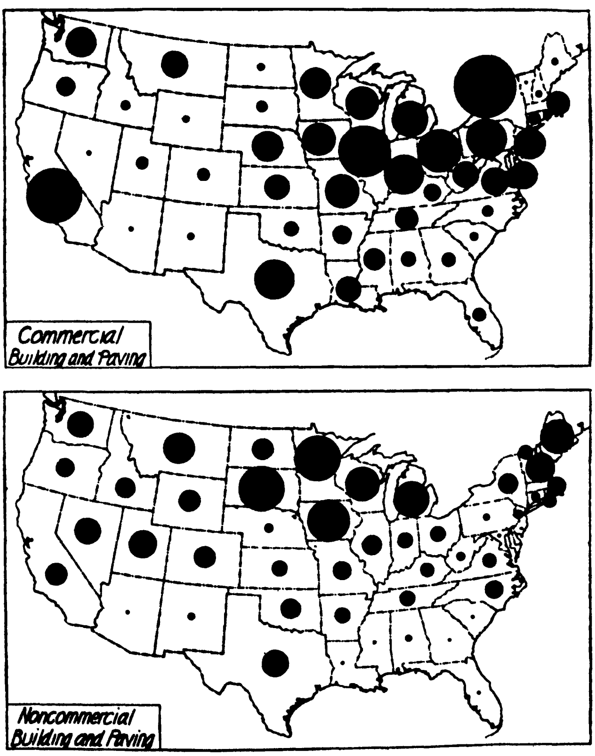


FIGURE 91.—Building and paving sand and gravel sold or used by commercial and noncommercial producers in 1935, by States. Areas of circles represent tonnage.

With the possible exceptions of Minnesota, Iowa, Wisconsin, and Michigan, most of the large noncommercial operations serve States where road materials are not available from commercial plants. The small noncommercial output reported in several States, notably Arizona and New Mexico, may be due to lack of complete data.

Method of transport.—Shipments of sand and gravel originating on class I railroads in 1936 totaled 40,213,215 short tons, an increase of 32 percent over 30,451,218 tons in 1935. This quantity represented 40 percent of total commercial production, exclusive of glass and molding sand and nonrevenue railroad ballast, compared with 43 percent in 1935. The trend from 1928 to 1933 was toward increased truck shipments of sand and gravel with the railroads carrying a smaller percentage of the total each year. In 1934 and 1935, however, rail shipments were relatively larger, indicating at least a temporary break in the increasing use of truck transportation, which apparently again was greater in 1936. (See fig. 92.)

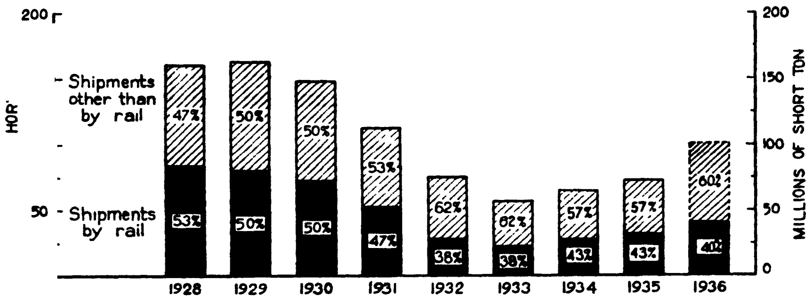


FIGURE 92.—Shipments of sand and gravel, by modes of transportation, 1928–36. Data on rail shipments are from reports of the Interstate Commerce Commission; to insure comparability, glass and molding sand, railroad ballast, and noncommercial production have been excluded from the figures used in the comparisons. Figures for 1936 are subject to revision.

Producers making nearly 90 percent of the total commercial output of sand and gravel in 1934 and 1935 reported the methods by which their product was transported. According to these figures, as summarized in the following table, waterway shipments in 1935 increased slightly at the expense of both rail and truck. Comparable data for 1936 are not yet available.

Sand and gravel sold or used by commercial producers in the United States, 1934–35, by methods of transport [1]

	1934		1935	
	Short tons	Percent of total	Short tons	Percent of total
Shipped by—				
Truck	21,447,749	31.7	23,480,830	31.3
Rail	38,762,817	57.4	42,318,644	56.4
Waterway	7,358,533	10.9	9,273,258	12.3
	67,569,099	100.0	75,072,732	100.0
Percent of total commercial production accounted for	89.7		88.7	

[1] For practical purposes the entire output of noncommercial operations commonly is moved by truck. Including noncommercial production, sand and gravel were moved as follows—1934: Truck 58 percent, rail 35 percent, and waterway 7 percent; 1935: Truck 55 percent, rail 37 percent, and waterway 8 percent.

Preparation.—In both 1934 and 1935 by far the larger part of the output of commercial operations was washed, screened, or otherwise prepared, whereas most of the noncommercial production was pit-run material. The average value per ton of prepared material was more than double that of unprepared.

Sand and gravel (prepared or unprepared) sold or used by producers in the United States, 1934–35, by commercial and noncommercial operations

	1934			1935		
	Short tons	Average value per ton	Percent of total	Short tons	Average value per ton	Percent of total
Commercial operations:						
Prepared	66, 865, 755	$0. 68	88. 8	71, 947, 628	$0. 65	85. 0
Unprepared	8, 457, 154	. 36	11. 2	12, 659, 843	. 34	15. 0
	75, 322, 909	. 64	100. 0	84, 607, 471	. 61	100. 0
Noncommercial operations:						
Prepared	9, 411, 195	. 56	22. 8	7, 308, 799	. 53	18. 6
Unprepared	31, 877, 585	. 24	77. 2	32, 007, 653	. 22	81. 4
	41, 288, 780	. 31	100, 0	39, 316, 452	. 27	100. 0

Size of plants.—In 1927 the Bureau of Mines compiled a table showing production of sand and gravel by size of companies.[2] A similar, although not absolutely comparable, compilation was made by size of plants for 1931 [3] and in the following table for 1935. A definite trend toward production of an increasing percentage of total output by small plants is apparent. This, however, indicates decreased output of existing plants in the later years as well as introduction of smaller producing units. In 1931, 32 percent of the total output was reported by plants producing less than 100,000 tons each, but this same-size group in 1935 accounted for 42 percent of the total. Regardless of this trend, however, the large plants still account for an appreciable part of the output; in 1935, 36 plants amounting to only 2 percent of the total number of plants reported 27 percent of the total production.

Number and output of commercial sand and gravel plants in 1935, by size groups [1]

Size group (short tons)	Plants [2]			Production		
	Number	Percent of total	Cumulative percent	Short tons	Percent of total	Cumulative percent
Less than 25,000	1, 139	61. 17	61. 17	9, 501, 000	11. 23	11. 23
25,000 to 49,999	307	16 49	77. 66	10, 983, 000	12. 98	24. 21
50,000 to 99,999	220	11. 82	89. 48	15, 305, 000	18. 09	42. 30
100,000 to 199,999	128	6. 87	96. 35	17, 329, 000	20. 48	62. 78
200,000 to 299,999	32	1. 72	98. 07	7, 768, 000	9. 18	71. 96
300,000 to 399,999	9	. 48	98. 55	3, 032, 000	3. 58	75. 54
400,000 to 499,999	12	. 65	99. 20	5, 251, 000	6. 21	81. 75
500,000 to 599,999	7	. 38	99. 58	3, 803, 000	4. 50	86. 25
600,000 to 699,999	1	. 05	99. 63	[3] 2, 884, 000	3. 41	89. 66
700,000 to 799,999	3	. 16	99. 79			
800,000 to 899,999	1	. 05	99. 84	[3] 8, 751, 000	10. 34	100. 00
900,000 to 999,999	----------	----------	99. 84			
1,000,000 to 1,999,999	1	. 05	99. 89			
2,000,000 and over	2	. 11	100. 00			
	1, 862	100. 00	100. 00	84, 607, 000	100. 00	100. 00

[1] Plants operated by or for States, counties, and municipalities and 11 producers reporting less than 100 short tons each are excluded.
[2] May include a few companies operating more than 1 plant but not submitting separate returns for individual plants.
[3] Combined to avoid revealing production of individual plants.

[2] Mineral Resources of the United States—part II, 1927, p. 163.
[3] Minerals Yearbook, 1932-33, p. 609.

153336—37——78

PRICES

Despite increased demand for sand and gravel for all uses in virtually every section of the country, average prices in 1936 showed little change from 1935. The average value per ton, f. o. b. plant, for all sand and gravel reported by commercial producers remained unchanged at $0.61. A slight weakness in sand prices resulted in a drop of 2 cents a ton in the average value of sand, but it was balanced by an advance of 2 cents for gravel.

Preliminary data indicate a slight increase in the average value of sand and gravel used in construction but a drop of 5 percent in that sold for paving. As building and paving combined account for about 80 percent of total sales by commercial producers, it is evident that any weakness in prices of these materials is reflected strongly in the average value of the product of the sand and gravel industry as a whole. The average value of the various industrial sands changed little from 1935. The rise in average value of both sand and gravel sold for miscellaneous uses shows the result of the omission in 1936 of large quantities of low-priced fill reported in 1935 for use in the construction of Fort Peck Dam. The indicated rise in average value of material produced at noncommercial operations may be due to the inclusion of a larger percentage of prepared material in 1936.

According to data presented at the annual meeting of the National Sand and Gravel Association, price declines were sharpest in the New York City area and in California, where price cutting at times during 1936 assumed the appearance of a price war. On the other hand, slightly increased prices were reported in Arkansas, Minnesota, Oklahoma, Texas, and western Pennsylvania. Apparently there was little change throughout the rest of the United States.

Wholesale price indexes of the Bureau of Labor Statistics, although based on relatively small samples, confirm the preliminary data on unit values. The price index of building sand dropped from 98.7 in 1935 to 98.2 in 1936, and that of gravel increased slightly—from 89.6 to 90.8.

MARKETS

About 80 percent of the sand and gravel produced at commercial operations in 1936 entered some form of building or highway construction. Indicators of these markets, therefore, are useful in following trends in demand for sand and gravel. Cement, paving asphalt, and cut-back asphalt shipments advanced 50, 36, and 44 percent, respectively, in 1936 compared with 1935. Furthermore, concrete-pavement contract awards were 31 percent higher and the value of construction contracts awarded increased 45 percent. These data substantiate the evidence of incomplete returns from producers, upon which the preliminary production figures for 1936 are based.

Sales of road oil in 1936 increased only 21 percent, although an advance of at least 35 percent in production of noncommercial pit-run material for use on low-type roads is indicated. The use of calcium chloride and even common salt in so-called "stabilized roads" is growing, but no data are available to show exact trends in use of these materials.

Summary of data relating to production and consumption of sand and gravel, 1935-36[1]

	1935	1936[2]	Percent of change in 1936
Sand and gravel shipments:			
Rail shipments, class I roads[3] ....short tons..	30,451,218	40,213,215	+32
Water shipments: Pittsburgh district[4] ....do....	1,766,427	3,166,847	+79
Correlative industries:			
Portland cement shipments ....barrels..	75,232,917	112,566,000	+50
Paving asphalt shipments ....short tons..	877,466	1,190,705	+36
Cut-back asphalt shipments ....do....	707,953	1,021,290	+44
Road oil sales ....barrels..	6,798,932	8,256,694	+21
Construction:			
Concrete pavement contract awards[5] ....square yards..	43,427,000	56,986,000	+31
Construction contract awards[6]	$1,844,546,000	$2,677,534,000	+45
Railway expenditures, class I roads: For ballast[7]	$11,438,000	$15,544,449	+36
Glass production:			
Glass containers[8] ....gross..	38,783,000	45,216,000	+17
Illuminating glassware[9] ....turns..	24,058	28,805	+20
Polished plate glass[10] ....square feet..	179,817,000	197,980,000	+10
Foundry activity:			
Foundry and malleable pig iron production ....gross tons..	2,824,822	3,802,582	+35
Malleable castings production[11] ....short tons..	466,395	571,696	+23
Freight car loadings, all commodities[12] ....cars..	31,518,000	36,686,000	+16

[1] Many of the data avilable in this table are published currently in "Survey of Current Business"; comparable data for 1928 are given in Minerals Yearbook, 1934, p. 839.
[2] Subject to revision.
[3] Interstate Commerce Commission.
[4] Chief statistician, Board of Engineers for Rivers and Harbors.
[5] Portland Cement Association.
[6] F. W. Dodge Corporation.
[7] Interstate Commerce Commission and Bureau of Railway Economics.
[8] Glass Container Association.
[9] Illuminating Glassware Guild.
[10] Plate Glass Manufacturers of America.
[11] U. S. Bureau of the Census.
[12] American Railway Association.

Increased ballast expenditures by class I railroads in 1936 confirm the indicated sharp advance in sales of sand and gravel ballast. Greater activity in glass plants, foundries, rail traffic, stone-finishing mills, and industry in general was responsible for increased sales of industrial sands.

NEW DEVELOPMENTS

Plant improvements in the sand and gravel industry in 1936 were designed to meet more rigid specifications for a wider variety of products. The increasing demand for a wider range of sands containing a higher percentage of finer sizes was an outstanding trend in the industry. Increased use of gravel, particularly crushed gravel in the finer sizes, in bituminous mixtures was also noteworthy. Producers have been able to meet changing demands, but lack of uniformity in specifications among Government agencies has resulted in higher costs for even the large operations. On the other hand, further progress was made during 1936 in standardizing aggregates used in highway construction. Several additional States revised their specifications to follow the recommendations of the Division of Simplified Practice and changed from round to square openings in test screens.

Foster and Walker[4] reported the results of research on strength and wear tests of gravel and crushed-stone-concrete. They concluded that the shape of the particles has little effect on strength, although

[4] Foster, Alexander, Jr., and Walker, Stanton, Wear and Strength Tests of Gravel and Crushed-Stone Concretes: Nat. Sand and Gravel Assoc. (mimeographed preprint), 1936, 20 pp.

rounded aggregates permit the use of a richer mortar because of the lower percentage of voids. Of particular interest was their finding that crushed stone rounded mechanically and used in concrete gave the same compressive and flexural strengths as angular crushed stone with the same cement content.

Several companies are operating mixing plants to prepare material for so-called "stabilized roads." Sand, gravel, and clay are mixed in the proper proportions with calcium chloride, sodium chloride, or possibly some other binding agent, and trucked to the job. This type of construction is becoming increasingly popular for low-cost secondary roads but probably does not afford a wide market for permanent plants, except under special conditions.

The use of conveyor belts for pit to plant and intraplant movement of materials apparently is increasing. The installation at Grand Coulee Dam has attracted much attention.[5]

A series of reports by J. R. Thoenen,[6] of the Bureau of Mines, covering prospecting, development, and operation of sand and gravel deposits was completed early in 1936. Some of these reports are now out of print, but the others may be procured from the Publications Section, United States Bureau of Mines, Interior Building, Washington, D. C. Copies are available for reference in virtually all libraries.

Health problems in the industry, particularly with respect to silicosis, received greater attention during 1936.

The National Industrial Sands Association was formed in April 1936. Producers of industrial sands first felt the need of an organization during the days of NRA and until the formation of the new association were organized as a division of the National Sand and Gravel Association.

FOREIGN TRADE [7]

Imports of sand and gravel are confined largely to movements of aggregates across the United States-Canada boundary and to shipments of Belgian glass sand, mostly consigned to the Pacific coast glass industry. Exports likewise are principally aggregates moving into Canada.

---

[5] Anable, Anthony, Preparation of High-Specification Sand at the Grand Coulee Dam: Am. Inst. Min. and Met. Eng. Tech. Pub. 715, 1936, 15 pp. Shaw, Edmund, Handles 2,500 Tons per Hour—Wastes 1,000 to 1,500 Tons of Sand: Rock Products, vol. 39, no. 3, 1936, pp. 30–40.

[6] Thoenen, J. R., Prospecting and Exploration for Sand and Gravel: Inf. Circ. 6668, Bureau of Mines, 1932, 52 pp. (Out of print.) Development of Sand and Gravel Deposits: Inf. Circ. 6689, Bureau of Mines, 1933, 50 pp. Sand and Gravel Excavation: Part 1—The Power Shovel, the Dragline Excavator, and the Excavator Crane: Inf. Circ. 6798, Bureau of Mines, 1934, pp. 1–44. (Out of print.) Sand and Gravel Excavation: Part 2—Power Scraper, Slack Line Cableway Excavator, and Hydraulic Giant: Inf. Circ. 6814, Bureau of Mines, 1935, pp. 45–96. (Out of print.) Sand and Gravel Excavation: Part 3—Hydraulic Dredge, Clamshell Dredge, Ladder Dredge, and Dipper Dredge: Inf. Circ. 6826, Bureau of Mines, 1935, pp. 97–132. (Out of print.) Sand and Gravel Excavation: Part 4—Car and Locomotive Haulage, Hoist and Rope Haulage, Remote Control Haulage: Inf. Circ. 6856, Bureau of Mines, 1935, pp. 133–178. Sand and Gravel Excavation: Part 5—Motor Truck Haulage, Conveyor Belt Haulage, Pumps and Pipe Lines, Barges and Towboats, Aerial Trams: Inf. Circ. 6875, Bureau of Mines, 1936, pp. 179–252. Sand and Gravel Excavation: Part 6—Mining Methods: Inf. Circ. 6879, Bureau of Mines, 1936, pp. 253–290.

[7] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Sand and gravel imported for consumption in the United States, 1934–36, by classes

Class	1934		1935		1936	
	Short tons	Value	Short tons	Value	Short tons	Value
Glass sand [1]	24,516	$46,094	44,291	$94,966	52,943	$117,706
Other sand [2]	36,016	33,635	62,225	51,658	124,013	62,193
Gravel	74,758	18,286	63,189	15,851	201,398	38,142
	135,290	98,015	169,705	162,475	378,354	218,041

[1] Classification reads "Sand containing 95 percent silica and not more than 0.6 percent oxide of iron and suitable for manufacture of glass."
[2] Classification reads "Sand, n. s. p. f."

Sand and gravel imported into the United States, 1934–36, by countries

Country	1934		1935		1936	
	Short tons	Value	Short tons	Value	Short tons	Value
North America:						
Canada	107,451	$29,324	119,689	$40,501	322,090	$80,508
Mexico	90	80			22	5
Europe:						
Belgium	24,538	46,279	44,398	95,181	51,039	111,246
France	241	2,301	3,720	4,119	223	1,840
Germany	432	6,078	187	2,868	190	2,328
Netherlands	241	2,904	1,037	16,233	931	12,135
U. S. S. R. (Russia in Europe)	1,624	9,644	560	3,302		
United Kingdom	672	1,368	101	192	3,859	9,979
Asia: Japan	1	37				
Oceania:						
Australia			2	49		
New Zealand			11	30		
	135,290	98,015	169,705	162,475	378,354	218,041

Sand and gravel exported from the United States, 1932–36

Year	Short tons	Value	Year	Short tons	Value
1932	96,015	$211,558	1935	37,393	$26,369
1933	82,453	54,557	1936	49,906	58,453
1934	33,550	41,649			

GYPSUM

By Carl A. Gnam

SUMMARY OUTLINE

As a result of continued improvement in the gypsum industry during 1936 production and sales reached the highest levels since 1930. The output of crude gypsum rock and gypsite from mines in the United States in 1936 was 2,712,510 short tons, or 42 percent more than the 1,903,880 tons obtained in 1935. Augmented by 661,595 short tons of imported crude rock, new supplies of gypsum in 1936 totaled 3,374,105 tons. Figure 93 shows trends in the gypsum industry from 1927 through 1936.

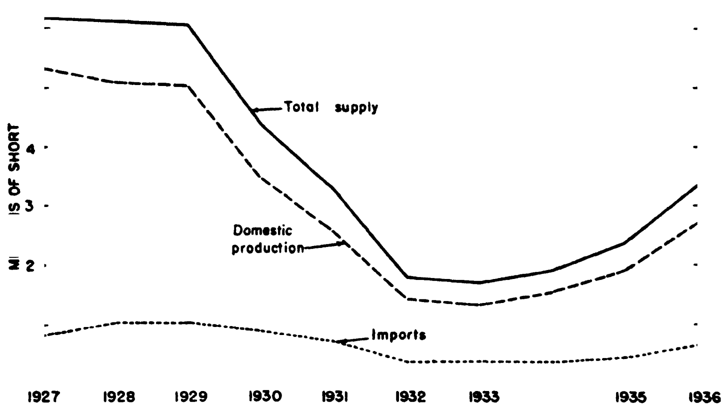


Figure 93.—Trends in domestic production, imports, and total supply of crude gypsum in the United States, 1927–36. Imports include small amounts of ground and calcined gypsum.

Sales of products made from domestic gypsum in 1936 were valued at $26,222,377. They included 752,625 short tons of uncalcined material valued at $1,458,123, sold as cement retarder, as land plaster, and for miscellaneous purposes, and 1,730,687 tons of calcined products

valued at $24,674,254, used principally as building materials. These amounts represent substantial increases over sales in 1935, when the total value was $18,860,348, including 520,594 tons of uncalcined material valued at $1,039,979 and 1,233,816 tons of calcined products valued at $17,820,369. Total sales of products manufactured from both domestic and foreign gypsum in 1936 were valued at $32,954,558, 39 percent more than in 1935 and the highest since 1930.

Salient statistics of the gypsum industry in the United States from 1932 to 1936 are summarized in the following table.

Salient statistics on gypsum and gypsum products in the United States, 1932–36

	1932	1933	1934	1935	1936
Crude gypsum:					
Mined..........short tons..	1,416,274	1,335,192	1,536,170	1,903,880	2,712,510
Imported..........do....	374,072	359,490	361,186	450,250	661,595
Apparent supply..........do....	1,790,346	1,694,682	1,897,356	2,354,130	3,374,105
Sales by domestic plants: [1]					
Raw gypsum:					
Short tons	516,136	491,273	578,947	595,130	830,683
Value	$1,216,388	$1,089,100	$1,266,945	$1,329,140	$1,865,673
Gypsum products:					
For building purposes: [2]					
Short tons	1,149,872	1,011,506	1,074,017	1,465,311	2,102,306
Value	$16,122,200	$14,085,071	$15,510,835	$21,499,934	$30,061,901
For manufacturing uses:					
Short tons	43,889	48,965	66,573	87,657	108,032
Value	$454,718	$470,041	$673,624	$858,071	$1,026,984
Total gypsum products sold:					
Short tons	1,193,761	1,060,471	1,140,590	1,552,968	2,210,338
Value	$16,576,918	$14,555,112	$16,184,459	$22,358,005	$31,088,885
Grand total sales:					
Short tons	1,709,897	1,551,744	1,719,537	2,148,098	3,041,021
Value	$17,793,306	$15,644,212	$17,451,404	$23,687,145	$32,954,558
Gypsum products imported: [3]					
Short tons	3,302	3,108	1,646	1,906	1,844
Value	$29,365	$33,413	$26,436	$28,094	$26,531
Exports:					
Plaster board, etc.:					
Square feet	1,981,685	1,646,733	1,895,700	1,929,348	(4)
Value	$46,175	$36,057	$43,041	$42,465	(4)
All other: [5]					
Short tons	4,919	5,333	4,852	9,245	(4)
Value	$91,025	$83,155	$90,451	$143,731	(4)

[1] Gypsum and gypsum products produced from rock of both domestic and foreign origin.
[2] Includes calcined gypsum sold to other manufacturers and for miscellaneous uses.
[3] Includes ground and calcined gypsum and Keene's cement, but not "Manufactures of which plaster of paris is the component material of chief value n. s. p. f." (principally statues, art goods, and novelties).
[4] Comparable data not available.
[5] Includes raw and calcined gypsum and gypsum products.

The rise in imports from 1925 to 1930 (see fig. 93), when domestic production and sales were dropping, resulted from an increase in the number of calcining plants erected along the Atlantic seaboard. The aggregate increased capacity of such plants consequently moderated the decline in imports after 1930, although the output of some operations using imported crude declined in about the same proportion as that of operations using domestic material.

General improvement in the gypsum industry was caused almost entirely by the rise in volume of building construction. (See fig. 94.) The Federal Reserve Board index of total construction, based on the 1923–25 average as 100, advanced from 37 in 1935 to 55 in 1936, an increase of 49 percent, which corresponds rather closely to the 42-percent rise in gypsum production. The gypsum industry was aided particularly by the 60-percent increase in privately financed con-

struction, principally for buildings, which furnished by far the greatest demand for gypsum products.

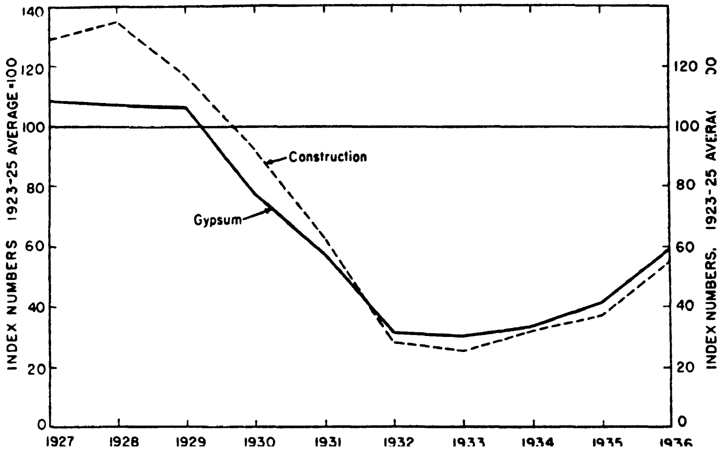


FIGURE 94.—Crude gypsum production compared with value of construction contracts awarded, 1927-36. Construction indexes compiled by the Federal Reserve Board.

DOMESTIC PRODUCTION

In 1936 crude gypsum was supplied by 65 mines operated in 17 States by 36 companies. Five operations, each of which includes an underground mine and a quarry, have been counted as 10 mines. About 60 percent of the total output was obtained from 36 underground mines, mostly in the East and Middle West. The remaining 40 percent was extracted from 28 quarries located principally in the West and Southwest, although 3 large operations in the Middle West (1 in Iowa and 2 in Michigan) supplied a considerable part of the total open-pit tonnage. Gypsite was produced at 10 quarries in 5 States.

Production increased in all States except two that always furnish relatively small amounts. The four leading States, in the order of their importance, were New York, Michigan, Iowa, and Texas, and their combined output (1,707,809 short tons) accounted for 63 percent of the total.

Gypsum mined, and uncalcined and calcined gypsum sold or used by producers, in the United States, 1932-36

Year	Number of active establishments [1]	Total quantity mined (short tons)	Sold or used by producers				
			Without calcining		Calcined		Total value
			Short tons	Value	Short tons	Value	
1932	57	1,416,274	444,816	$929,567	890,495	$11,976,719	$12,906,286
1933	61	1,335,192	420,935	806,325	821,738	11,121,153	11,927,478
1934	64	1,536,170	512,317	970,828	902,539	12,791,149	13,761,977
1935	65	1,903,880	520,594	1,039,979	1,233,816	17,820,369	18,860,348
1936	65	2,712,510	752,625	1,458,123	1,730,687	24,764,254	26,222,377

[1] Each mine, plant, or combination mine and plant is considered as 1 establishment.

Gypsum mined, and uncalcined and calcined gypsum sold or used by producers, in the United States in 1936, by States

State	Number of active establishments [1]	Total quantity mined (short tons)	Sold or used by producers				
			Uncalcined		Calcined		Total value
			Short tons	Value	Short tons	Value	
California	6	142,853	31,832	$102,652	(2)	(2)	(2)
Colorado	4	27,424	9,549	21,752	(2)	(2)	(2)
Iowa	9	344,221	97,511	146,233	217,088	$3,115,155	$3,261,388
Michigan	8	496,611	139,708	276,798	320,106	4,472,152	4,748,950
Nevada	3	167,342	70,384	148,632	(2)	(2)	(2)
New York	11	609,204	185,155	377,571	398,700	6,207,706	6,585,277
Oklahoma	4	156,545	63,364	70,887	(2)	(2)	(2)
Texas	5	257,773	47,085	71,303	187,469	2,860,438	2,931,741
Other States [3]	15	510,537	108,037	242,295	[4] 607,324	[4] 8,108,803	[4] 8,695,021
	65	2,712,510	752,625	1,458,123	1,730,687	24,764,254	26,222,377

[1] Each mine, plant, or combination mine and plant is considered as 1 establishment.
[2] Included under "Other States."
[3] Arizona, Idaho, Kansas, Montana, Ohio, South Dakota, Utah, Virginia, and Wyoming.
[4] Also includes sales from California, Colorado, Nevada, and Oklahoma.

Employment.—The improved employment situation at the mines in 1936 clearly reflected the stimulation of production resulting from the greater demand for gypsum. A comparison of data for 41 identical mines which supplied 74 percent of the total output indicates not only an increase of 23 percent in the number of men employed in 1936 compared with 1935 but also an average gain of 43 working days, which combined resulted in a 51-percent rise in the number of man-shifts. The decline in production per man-shift may have been caused by increased maintenance and development work, which had been reduced to a minimum in previous years when operating economies were necessary.

Employment and production at 41 identical gypsum mines, 1935–36 [1]

Year	Employment			Production			
	Number of men	Average number of days	Number of man-shifts	Short tons	Percent of total	Per man-shift (short tons)	Per man-year (short tons)
1935	873	187	163,252	1,488,070	78.2	9.1	1,705
1936	1,074	230	246,777	1,992,475	73.5	8.1	1,855
Percent of change in 1936	+23.0	+23.0	+51.2	+33.9		−11.0	+8.8

[1] Includes 28 underground and 13 open-pit mines.

Calcining.—Gypsum of domestic and foreign origin was calcined during 1936 at 52 plants in 16 States. Of these plants, 41, most of which were adjacent to mines, calcined domestic gypsum and gypsite, and 11 on the East and West seaboards used only imported crude rock. In all, 187 kettles and kilns were operated, with a total daily capacity of 27,962 short tons. The reduction in capacity of 1,033 tons from 1935, which occurred in spite of the operation of two additional plants, resulted from the operation of eight fewer kettles and one less kiln.

Active calcining kettles and kilns in the United States in 1936, by States

[Reported by gypsum operators using domestic and imported gypsum]

State	Number of calcining plants	Kettles		Rotary kilns		Total daily capacity (short tons)
		Number	Daily capacity (short tons)	Number	Daily capacity (short tons)	
Iowa	5	19	2,958			2,958
Michigan	5	22	2,692			2,692
New York	6	18	2,400	5	2,200	4,600
Texas	4	30	2,512			2,512
Other States [1]	21	[2] 54	[2] 6,481	6	2,715	[2] 9,196
Total, plants using domestic gypsum:						
1936	41	[2] 143	[2] 17,043	11	4,915	[2] 21,958
1935	40	[2] 154	[2] 17,431	12	5,090	[2] 22,521
Total, plants using imported gypsum: [3]						
1936	11	28	3,014	5	2,990	6,004
1935	10	25	3,544	5	2,930	6,474

[1] California, Colorado, Indiana (crude gypsum from Michigan), Kansas, Montana, Nevada, Ohio, Oklahoma, South Dakota, Utah, Virginia, and Wyoming.

[2] Includes 3 "beehives" (reported capacity 45 tons) and 4 vertical kilns (reported capacity 40 tons).

[3] Arizona, California, Connecticut, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, and Vermont.

DISTRIBUTION OF SALES

Domestic gypsum.—Most sales of domestic gypsum comprise calcined products used as building materials. In 1936 these products totaled 1,621,401 short tons, including the weight of admixtures such as fiber, sand, hair, and paper, and were valued at $23,768,386. Obviously, the increases in this classification of 43 percent in quantity and 41 percent in value over 1935 were responsible for most of the gain in total sales of all products. Sales of base-coat plasters again led all other items in value, although before 1935 sales of wallboard had led for many years. The most outstanding development was the rise in sales of plaster board and lath to a new all-time peak of 255,688 short tons valued at $5,601,619. The greatest value previously reported for these products was $4,260,087 in 1930, and the largest quantity was 252,813 short tons in 1928. Substantial increases over 1935 were also shown in sales of all other products except insulating materials, which declined about 50 percent. The largest increase occurred in the classification "Other building purposes." This includes for the most part joint filler and patching plaster, which are sold in small quantities at relatively high prices, accounting for the high value per ton.

Calcined gypsum for manufacturing purposes is sold principally to plate-glass, terra-cotta, and pottery works. Sales to all classes of consumers except pottery works gained over 1935, resulting in total increases of 21 percent in quantity and 12 percent in value.

Trends in sales of uncalcined gypsum are influenced largely by demands from portland-cement manufacturers who require raw gypsum as a retarder in their product. Consequently, the 41-percent increase in quantity sold for that purpose in 1936 follows closely the 49-percent gain in cement shipments during the year. The slight rise in quantity of agricultural gypsum sold was characteristic of the trend in consumption of all fertilizers, although the value was some-

what less than in 1935. Sales of gypsum in 1936 "For other purposes" were about double those in 1935, owing to a greater demand for fillers.

Crude gypsum, and gypsum products made from domestic crude gypsum, sold or used by producers in the United States, 1935-36, by uses

Use	1935		1936	
	Short tons	Value	Short tons	Value
Without calcining:				
To portland-cement mills	453,706	$812,694	641,351	$1,163,643
For agriculture	25,703	137,298	27,378	116,430
For other purposes [1]	41,185	89,987	83,893	178,050
Total without calcining	520,594	1,039,979	752,625	1,458,123
Calcined:				
For building purposes:				
Base-coat plasters	626,382	6,179,542	782,472	7,256,543
Sanded plasters	59,822	376,205	98,437	780,704
Finished plasters	63,583	799,435	122,132	1,327,137
Molding plasters	26,378	362,874	41,260	516,325
Keene's cement	22,502	278,914	32,167	497,223
Plasterboard and lath [2]	135,620	2,873,310	255,688	5,601,619
Wallboard [3]	147,099	5,515,944	207,733	6,885,737
Partition tile [4]	41,069	289,250	57,466	431,938
Insulating materials	3,798	43,773	1,657	23,559
Other building purposes [5]	8,088	166,310	22,389	447,601
Total for building purposes	1,134,341	16,885,557	1,621,401	23,768,386
For manufacturing uses:				
To plate-glass works	23,665	139,518	30,526	177,357
To terra-cotta works	748	7,405	2,632	17,147
To pottery works	37,231	370,099	35,991	367,249
For other manufacturing uses [6]	21,116	285,956	31,016	335,982
Total for manufacturing uses	82,760	802,978	100,165	897,735
For other purposes [7]	16,715	131,834	9,121	98,133
Total calcined	1,233,816	17,820,369	1,730,687	24,764,254
Grand total value		18,860,348		26,222,377

[1] Includes gypsum sold for paper or other filler, insulating materials, paint manufacturing, and rock dust.
[2] 1935: 191,289,518 square feet; 1936: 362,533,715 square feet.
[3] 1935: 211,042,247 square feet; 1936: 295,458,380 square feet.
[4] 1935: 6,954,337 square feet; 1936: 10,207,546 square feet.
[5] Includes joint filler, patching and acoustic plaster, roofing tile, other tile, and pyrofill.
[6] Includes dental plaster, hydrocal, coecal, casting and molding plaster, paper and paint filler, and stucco.
[7] Includes calcined gypsum sold to other manufacturers and for miscellaneous uses.

Imported gypsum.—Sales of products manufactured from imported gypsum were valued at $6,732,181 in 1936 and comprised 20 percent of the total value of products made from both domestic and foreign gypsum. The increase over 1935, amounting to 40 percent, was virtually the same as the 39-percent rise in sales of products made from domestic rock. Gains occurred during 1936 in sales of all classifications of calcined products except molding plaster, the decline in which was more than offset by the unusually large sales of finishing plasters. The quantity and value of sales of the uncalcined products were also larger in 1936, although sales of agricultural gypsum, the most important item in the group, declined slightly. Sales to cement mills increased 142 percent in value, and sales of uncalcined gypsum for other purposes (which were almost negligible in 1935) were 5,504 tons, valued at $66,087, in 1936. It was used mostly as filler.

Imported crude gypsum, and gypsum products made from imported crude gypsum, sold or used in the United States, 1935–36, by uses, as reported to the Bureau of Mines by the importers

Use	1935		1936	
	Short tons	Value	Short tons	Value
Without calcining:				
To portland cement mills	21,671	$50,815	25,522	$123,155
For agriculture	52,822	238,129	47,032	218,308
For other purposes	43	217	5,504	66,087
Total without calcining	74,536	289,161	78,058	407,550
Calcined:				
For building purposes:				
Base-coat plasters	159,439	1,570,882	249,638	2,368,589
Sanded plasters	16,889	129,607	23,528	154,742
Finished plasters	19,549	331,617	62,997	1,101,701
Molding plasters	38,269	531,041	10,902	173,207
Partition tile	11,814	104,041	30,636	259,906
For other building purposes [1]	68,295	1,815,355	94,083	2,137,237
Total for building purposes	314,255	4,482,543	471,784	6,195,382
For manufacturing uses [2]	4,897	55,093	7,867	129,249
Total calcined	319,152	4,537,636	479,651	6,324,631
Grand total value		4,826,797		6,732,181

[1] Includes calcined gypsum used for Keene's cement, plasterboard, lath, wallboard, roofing tile, insulating materials, and other building purposes, and calcined gypsum sold to other gypsum manufacturers and for miscellaneous uses.
[2] Includes gypsum sold to potteries and for other manufacturing uses.

PRICES

Average values per ton of gypsum products, f. o. b. mills, as reported by producers, are used to indicate trends in prices, as market quotations are not available for many of the producing sections of the country. Prices thus indicated declined slightly in 1936, contrary to the Bureau of Labor Statistics indexes for all commodities and for building materials in general, which gained 1.0 and 1.6 percent, respectively. A 3-percent drop in unit value of raw sales was influenced by agricultural gypsum, which was valued at $4.25 per short ton in 1936, compared with $5.34 per ton in 1935, and by sales "For other purposes", which declined from $2.18 in 1935 to $2.12 in 1936. The increase in value of gypsum sold to cement mills from $1.79 a ton in 1935 to $1.81 in 1936 prevented a more drastic reduction in the average value of all material sold raw. The average values of gypsum sold for use in cement manufacture varied considerably in different States, ranging from $1.05 to $2.93 per ton.

The small decline in the average value of calcined products was caused by a drop of $4.35 per ton in the price of wallboard and smaller decreases in prices of building plasters despite gains in the unit value of Keene's cement, and plasterboard and lath. The range in average values of some of the more important products was: Base-coat plaster, $5.85 to $10.55 per ton; wallboard, $28.71 to $41.71; and plasterboard and lath, $19.06 to $35.46.

The realization per ton on gypsum mined, computed by dividing the total sales value by the number of tons produced, indicates fairly well the general trend in average prices of all products. The value of $9.67 in 1936 was 2 percent lower than in 1935 but still was considerably higher than in 1934 and previous years.

Average values per short ton of gypsum and gypsum products (made from domestic crude gypsum) sold or used by producers in the United States, in selected years from 1910 to 1936

Use	1910	1920	1925	1929	1931	1933	1935	1936
Sold without calcining:								
To portland-cement mills	$1.56	$3.58	$2.66	$1.88	$1.91	$1.78	$1.79	$1.81
For agriculture	2.05	5.19	5.92	4.23	4.89	5.57	5.34	4.25
For other purposes	1.10	3.32	7.19	2.88	1.99	2.25	2.18	2.12
Average raw sales	1.59	3.83	2.78	1.97	2.02	1.92	2.00	1.94
Calcined products:								
Base-coat plasters	(1)	(1)	(1)	(1)	7.99	8.79	9.87	9.27
Building plasters, total	[2] 3.78	[3] 9.92	[3] 7.48	5.15	7.99	9.10	9.94	9.46
Keene's cement	(1)	14.90	13.75	14.67	14.36	14.35	12.40	15.46
Plasterboard and lath	(1)	(1)	24.99	15.17	18.09	19.26	21.19	21.91
Wallboard	(1)	(1)	32.66	20.10	30.70	34.14	37.50	33.15
Average calcined sales [4]	3.43	11.53	10.93	8.69	12.07	13.53	14.44	14.31
Sales realization per ton crude gypsum mined [5]	2.74	7.84	8.38	6.24	8.13	8.93	9.91	9.67

[1] Figures not available.
[2] Includes Keene's cement and some dental plaster and other products.
[3] Includes some dental plaster and other products.
[4] The increase in this item before 1925 was due largely to increasing integration, as some wallboard and other high-priced products were made by plants owned by gypsum producers instead of outside plants purchasing their raw or calcined gypsum from the primary producers.
[5] Calculated by dividing total value of all sales by tons of crude gypsum mined.

NEW DEVELOPMENTS

Increased demand for gypsum products and generally higher prices encouraged more plant improvements and expansion in 1936 than had taken place in many years. Additional properties adjoining old workings were acquired by at least one company. Plants on the East coast using imported rock, and mines in Canada supplying them, were acquired by one of the larger domestic producers. A new mine was opened in Idaho which produced a small amount of rock by the open-pit method for use as cement retarder. Tube milling continued to be a live topic, and tube mills were installed for the first time by a few producers.

An electric furnace for calcining gypsum was described[1] as having the essential advantage of regulation and maintenance of the optimum temperature. By elimination of the hot flame, the ordinary heavy kettle can be replaced by one of light construction. The power consumption in practice is 160 to 180 kilowatt-hours per 1,000 kilograms of gypsum, varying with the water to be driven off.

FOREIGN TRADE[2]

Imports.—Foreign trade in gypsum consists mainly of imports of crude rock from Canada. Most of the material is obtained from quarries near tidewater in Nova Scotia and New Brunswick and shipped by boat to ports on the New England and Mid-Atlantic seaboards. Mexico, which ranks second as a source of imported gypsum, annually supplies less than 10 percent of the total. The

[1] Pit and Quarry, vol. 29, no. 5, November 1936, p. 70.
[2] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

rock from that source is quarried in Lower California and transported in boats to the larger ports on the West coast.

Imports of crude gypsum in 1936 were 661,595 short tons valued at $620,943 and, as in former years, exceeded the tonnage and fell short of the value furnished the Bureau of Mines by importers. Imports other than crude consisted of raw ground gypsum, calcined gypsum, plaster of paris, and Keene's cement. The only substantial gain was in the value of plaster of paris—$34,722 in 1936 compared with $20,958 in 1935.

Crude gypsum imported into the United States, 1934–36, by countries

Country	1934		1935		1936	
	Short tons	Value	Short tons	Value	Short tons	Value
Canada	329,835	$341,283	408,908	$424,752	616,080	$579,546
Hong Kong					1	24
Italy			394	1,679	50	1,203
Mexico	31,351	29,799	40,948	36,619	45,464	40,170
	361,186	371,082	450,250	463,050	661,595	620,943

Gypsum imported for consumption in the United States, 1932–36

Year	Crude		Ground		Calcined		Manufactured plaster of paris (value)	Keene's cement		Total value
	Short tons	Value	Short tons	Value	Short tons	Value		Short tons	Value	
1932	374,072	$346,766	2,076	$14,762	1,174	$13,561	$17,948	52	$1,042	$394,079
1933	359,490	373,919	1,907	18,032	1,177	14,781	13,305	24	600	420,637
1934	360,186	371,082	1,085	14,880	534	10,890	16,859	27	666	414,377
1935	450,250	463,050	1,241	15,440	601	11,364	20,958	64	1,290	512,102
1936 [1]	661,595	620,943	1,374	16,937	450	8,778	34,722	20	816	682,196

[1] Excludes 15,394 short tons valued at $36,182 classified as "crude plaster rock (including anhydrite)."

Crude gypsum imported, and uncalcined and calcined gypsum from imported rock sold or used, in the United States, 1925–34, as reported to the Bureau of Mines by the importers

Year	Number of importers	Crude imported (short tons)	Sold or used by the importer				
			Without calcining		Calcined		Total value
			Short tons	Value	Short tons	Value	
1932	14	351,723	71,320	$286,821	303,266	$4,600,199	$4,887,020
1933	13	340,337	70,338	282,775	238,733	3,433,959	3,716,734
1934	14	345,094	66,630	296,117	238,051	3,393,310	3,689,427
1935	14	[1] 426,841	74,536	289,161	319,152	4,537,636	4,826,797
1936	15	[1] 614,218	78,058	407,550	479,651	6,324,631	6,732,181

[1] Value: 1935, $867,487; 1936, $1,136,988.

Exports.—Export data for 1936 are not entirely comparable with those for previous years owing to changes in classifications. However, it is significant that the total value of gypsum exports in 1936 ($277,522) was 49 percent greater than the total of $186,196 in 1935.

Gypsum and gypsum products exported from the United States, 1932–36

Year	Crude, crushed, or ground		Plasterboard and wallboard		Plaster, calcined, and manufactures, n. e. s	
	Short tons	Value	Square feet	Value	Short tons	Value
1932	3,580	$18,931	1,981,685	$46,175	1,339	$72,094
1933	3,774	11,049	1,646,733	36,057	1,559	72,106
1934	2,588	11,652	1,895,700	43,041	2,264	78,799
1935	4,528	15,473	1,929,348	42,465	4,717	128,258
1936	(1)	[2] 105,354	(1)	(3)	(1)	[2 3] 172,168

[1] Quantity not available.
[2] Value for calcined included with "Crude, crushed, or ground"
[3] Value for "Plasterboard and wallboard" included with "Plaster, calcined, and manufactures, n. e. s"

WORLD PRODUCTION

The widespread occurrence of gypsum and its low value per ton in the crude form, which limits its transportation to relatively short distances, have encouraged production in virtually all parts of the world. Total world production reached a peak of 13,000,000 metric tons in 1929. Declines in the next 4 years reduced the quantity to 7,400,000 tons in 1933, but since then gains have been made annually. Only partial data are available for 1936, but the upward trend apparently continued.

The United States, normally the largest gypsum-producing country in the world, has been exceeded as a producer by France since 1931. Other large producers in the order of their importance are Great Britain, Germany, Spain, U. S. S. R. (Russia), Italy, and Canada. The output in Great Britain has been maintained at a high level for a number of years due to an extensive building program undertaken there during the depression. Germany, too, has had a relatively high production for several years, and if more complete figures were available Germany might prove to be even nearer the lead as a world producer.

Canada, which ranks about eighth in volume of output, has a greater export trade in gypsum than any other country, due to the proximity of the eastern deposits to tidewater and cheap transportation to large population centers in the United States. Moreover, trade with Great Britain has been stimulated by affiliation of producers in Canada with manufacturers in England and by the relative proximity of the new operation at Cape Breton, which is about a third of the way from New York to England.

World production of gypsum, 1932–36, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1932	1933	1934	1935	1936
Algeria	90,550	86,220	83,920	56,710	(2)
Argentina [3]	33,543	34,805	44,142	(4)	(2)
Australia:					
New South Wales	2,481	2,307	2,753	1,722	(2)
South Australia	45,684	51,373	76,449	103,909	(2)
Victoria	2,951	5,214	6,499	8,852	(2)
Western Australia	3,706	2,653	5,392	5,450	(2)
Austria [5]	36,000	45,000	45,000	46,000	(2)
Brazil [6]	2,000	2,000	2,000	2,000	2,000
Canada	398,883	336,283	447,507	491,572	(7)
Chile	11,989	15,204	10,901	3,030	(2)
China	64,508	64,020	67,720	(4)	68,800
Cyprus [8]	10,995	12,881	9,217	14,851	16,603
Egypt	236,795	238,721	149,713	190,666	(2)
Estonia	8,299	5,670	4,905	6,238	(2)
France	2,081,010	1,689,050	1,453,450	(4)	(2)
Germany [9]	398,500	485,000	810,000	855,000	(2)
Greece	2,167	3,535	4,525	(4)	(2)
India, British	52,246	33,674	47,507	46,045	(2)
Italy	529,821	534,026	458,978	471,148	(2)
Japan	(4)	(4)	(4)	127,633	137,677
Latvia [10]	36,812	48,251	82,801	83,202	(2)
Luxemburg	9,403	12,864	10,689	29,474	(2)
Mexico	61,795	(4)	(4)	54,514	61,711
Morocco, French	39,080	(4)	(4)	(4)	(2)
New Caledonia	11,900	11,565	13,585	(4)	(2)
Palestine	1,481	2,602	3,431	4,543	(2)
Peru	6,553	7,000	8,000	10,000	(2)
Portugal	4,385	7,492	20,315	4,800	(2)
Rumania	40,018	57,094	47,176	(4)	(2)
Spain	697,230	709,246	741,245	(4)	(2)
Sweden	115	49	121	(4)	(2)
Tunisia	26,000	17,580	15,550	11,000	(2)
U. S. S. R. (Russia)	493,000	474,000	688,000	(4)	(2)
Union of South Africa	7,113	11,809	23,296	21,590	(2)
United Kingdom:					
Great Britain	1,011,399	1,000,865	977,014	907,673	(2)
Northern Ireland	41				
United States	1,284,815	1,211,259	1,393,583	1,727,162	2,460,735
Yugoslavia [11]	(4)	842	(4)	(4)	(2)
	7,800,000	7,400,000	8,000,000	8,300,000	(2)

[1] In addition to the countries listed, gypsum is produced in Cuba and Switzerland, but production data are not available.
[2] Data not available.
[3] Rail and river shipments.
[4] Data not available; estimate included in total.
[5] Estimate furnished by Bundesministerium für Handel und Verkehr.
[6] Approximate production.
[7] Data for crude gypsum mined not available. Shipments of crude (lump, crushed, and ground) and calcined gypsum amounted to 741,165 tons.
[8] Exports of crude and calcined gypsum.
[9] Figures supplied by Deutscher Gips-Verein, E. V., Berlin, Germany. Figures are exclusive of rock gypsum mined and used by cement, paint, and other factories from their own quarries.
[10] Exports.
[11] Serbia only.

LIME [1]

By Oliver Bowles and A. T. Coons

SUMMARY OUTLINE

Sales of lime, which increased substantially during 1935, attained much higher levels in 1936. According to preliminary figures sales by producers in 1936 totaled 3,783,000 short tons valued at $27,464,000, an increase of 27 percent in quantity and 26 percent in value over 1935. The average value per ton was $7.26 in 1936 compared with $7.28 in 1935. Sales of hydrated lime in 1936, which are included in the total given above, were 1,216,000 short tons valued at $9,700,000, an increase of 21 percent in quantity and 22 percent in value compared with 1935. The average value per ton of hydrated lime was $7.98 in 1936 and $7.90 in 1935.

The table of salient statistics shows sales by uses. The most striking increase was in shipments of building lime; the gain of 41 percent reflects the substantial improvement in construction during 1936. Although building contracts reached 55 percent of the 1923–25 average, sales of building lime were only 39 percent of the maximum reached in 1925. Lime has evidently lost ground to competitive products in this important field.

Shipments of dead-burned dolomite for use as a furnace refractory (557,000 short tons valued at $4,693,000) advanced 22 percent in quantity and 24 percent in value over 1935. The production of steel ingots increased 43 percent, but a similar gain in consumption of refractories was not to be expected as the large sales in 1934 and 1935 covered both current requirements and the accumulated demand due to postponement of purchases during the depression years. The foregoing figures do not cover the entire consumption of dead-burned dolomite, because some steel companies calcine dolomite which they purchase raw. Such purchases are recorded in the chapter on Stone under shipments of raw dolomite.

Shipments of chemical and fluxing lime reached 1,988,000 short tons valued at $12,651,000, a gain of 25 percent over 1935. This gain may

[1] Figures for 1936 are preliminary; detailed data with final revisions will be released later.

be attributed partly to greater steel-making activity as about one-third of the lime included in this category is used in iron and steel works. The use of lime in water purification has increased notably. Likewise, most of the chemical and manufacturing industries employing lime, especially paper mills, tanneries, glass factories, and miscellaneous chemical works, increased their consumption.

Shipments of agricultural lime (315,000 short tons valued at $2,128,000) increased 11 percent.

The following table summarizes the principal statistics of the lime industry in 1936 compared with 1935.

Salient statistics of the lime industry in the United States, 1935-36

	1935	1936 [1]	Percent of change in 1936
Sales by producers:			
Total lime:			
Short tons	2,987,133	3,783,000	+26.6
Value	$21,748,655	$27,464,000	+26.3
Per ton	$7.28	$7.26	-.3
Hydrated lime (included in total):			
Short tons	1,005,619	1,216,000	+20.9
Value	$7,939,513	$9,700,000	+22.2
Per ton	$7.90	$7.98	+1.0
By uses:			
For building:			
Short tons	656,894	923,000	+40.5
Value	$5,716,802	$7,992,000	+39.8
Per ton	$8.70	$8.66	-.5
For agriculture:			
Short tons	282,660	315,000	+11.4
Value	$1,901,839	$2,128,000	+11.9
Per ton	$6.73	$6.76	+.4
For chemical uses (exclusive of dead-burned dolomite):			
Short tons	1,592,321	1,988,000	+24.8
Value	$10,344,180	$12,651,000	+22.3
Per ton	$6.50	$6.36	-2.2
Dead-burned dolomite:			
Short tons	455,258	557,000	+22.3
Value	$3,785,834	$4,693,000	+24.0
Per ton	$8.32	$8.43	+1.3
Imports:			
Quicklime and hydrated lime:			
Short tons	4,443	9,204	+107.2
Value	$46,603	$87,158	+87.0
Per ton	$10.49	$9.47	-9.7
Dead-burned dolomite:			
Short tons	7,519	13,928	+85.2
Value	$189,714	$349,678	+84.3
Per ton	$25.23	$25.11	-.5
Exports (lime):			
Short tons	3,927	4,601	+17.2
Value	$63,672	$71,109	+11.7
Per ton	$16.21	$15.46	-4.6

[1] Subject to revision.

PRODUCTION

The following table shows total lime sold or used by producers in recent years.

Lime sold or used by producers in the United States, 1932–36

Year	Number of plants in operation	Short tons	Value [1]	
			Total	Average
1932	343	1,959,990	$12,302,231	$6.28
1933	332	2,269,280	14,253,659	6.28
1934	324	[2] 2,397,087	[2] 17,164,024	7.16
1935	301	[2] 2,987,133	[2] 21,748,655	7.28
1936 [3]	300	3,783,000	27,464,000	7.26

[1] Value given represents value of bulk lime f. o. b. at point of shipment and does not include cost of barrel or package.
[2] 1934: Includes 129,290 short tons valued at $671,864, used by producers (captive tonnage); 1935: 143,716 tons valued at $750,155.
[3] Subject to revision.

Production by States.—Data are not yet available on production by States for 1936. The following table shows output by States for 1935. Ohio leads, and Pennsylvania stands second. These two States together produced over 41 percent of the total. Other States producing more than 100,000 tons each, in order of importance, were Missouri, West Virginia, Tennessee, Virginia, Alabama, and Illinois.

Lime sold or used by producers in the United States in 1935, by States

State	Number of plants in operation	Short tons	Value	State	Number of plants in operation	Short tons	Value
Alabama	9	127,157	$803,186	New Jersey	4	5,515	$42,161
Arizona	4	22,048	227,658	New Mexico	3	(1)	(1)
Arkansas	2	(1)	(1)	New York	10	59,110	462,363
California	8	49,141	491,549	North Carolina	1	(1)	(1)
Colorado	3	(1)	(1)	Ohio	21	707,358	5,690,656
Connecticut	1	(1)	(1)	Oregon	2	(1)	(1)
Florida	3	13,572	126,035	Pennsylvania	84	531,501	3,703,339
Georgia	1	5,192	40,689	Puerto Rico	3	4,792	43,226
Hawaii	1	6,715	70,474	Rhode Island	1	(1)	(1)
Idaho	2	(1)	(1)	South Dakota	2	(1)	(1)
Illinois	7	117,602	878,746	Tennessee	10	146,622	814,834
Indiana	7	71,883	442,803	Texas	8	38,863	362,636
Kentucky	1	(1)	(1)	Utah	8	15,957	152,586
Louisiana	1	(1)	(1)	Vermont	5	37,143	274,792
Maine	2	(1)	(1)	Virginia	25	133,696	850,444
Maryland	11	39,528	300,021	Washington	5	34,471	347,399
Massachusetts	5	67,969	642,755	West Virginia	9	211,904	1,404,087
Michigan	3	35,401	260,097	Wisconsin	12	39,324	347,656
Minnesota	2	(1)	(1)	Undistributed		152,207	1,208,545
Missouri	10	312,462	1,759,918				
Montana	3	(1)	(1)		301	2,987,133	21,748,655
Nevada	2	(1)	(1)				

[1] Included under "Undistributed."

Hydrated lime.—Lime in hydrated form is more satisfactory than quicklime for many uses, therefore it has become an important product of the lime industry. The following table shows sales for the past 5 years.

Hydrated lime sold or used by producers in the United States, 1932–36

Year	Number of plants in operation	Short tons	Value	
			Total	Average
1932	158	852,251	$5,370,273	$6.30
1933	157	840,007	5,622,026	6.69
1934	165	829,430	6,324,623	7.63
1935	167	1,005,619	7,939,513	7.90
1936 [1]	165	1,216,000	9,700,000	7.98

[1] Subject to revision.

The following table shows production of hydrated lime by States in 1935. Ohio, Pennsylvania, and Missouri are the principal producers.

Hydrated lime sold or used by producers in the United States in 1935, by States [1]

State	Short tons	Value	State	Short tons	Value
Alabama	21,728	$162,020	Pennsylvania	170,517	$1,292,033
California	11,650	124,780	Tennessee	38,272	292,782
Florida	8,103	78,699	Texas	20,749	195,969
Georgia	5,192	40,689	Vermont	8,961	64,549
Hawaii	6,698	70,219	Virginia	55,949	395,423
Illinois	24,267	187,651	Washington	5,078	54,958
Indiana	31,504	214,223	West Virginia	43,649	297,017
Maryland	24,312	192,461	Wisconsin	10,782	85,240
Massachusetts	22,971	191,406	Undistributed [2]	80,621	676,229
Missouri	108,824	713,675			
New York	15,844	131,737		1,005,619	7,939,513
Ohio	289,948	2,477,753			

[1] For shipments from plants in the United States and in Ohio, by destinations, see p. 1254.
[2] Arizona, Arkansas, Colorado, Connecticut, Idaho, Kentucky, Louisiana, Maine, Michigan, Minnesota, Montana, Nevada, New Jersey, North Carolina, Oregon, Rhode Island, South Dakota, and Utah.

CONSUMPTION BY USES

Lime is regarded as an essential raw material in many manufacturing industries. Much information on its uses is contained in a recent Bureau report.[2]

The following table shows consumption by principal uses in 1935 and 1936.

Lime sold or used by producers in the United States, 1935–36, by uses

Use	1935		1936 [1]	
	Short tons	Value	Short tons	Value
Agricultural	282,660	$1,901,839	315,000	$2,128,000
Building	656,894	5,716,802	923,000	7,992,000
Chemical:				
Glass works	91,714	641,081	(2)	(2)
Metallurgy	452,759	2,737,419	(2)	(2)
Paper mills	344,531	2,205,155	(2)	(2)
Sugar refineries	20,374	183,374	(2)	(2)
Tanneries	71,382	511,255	(2)	(2)
Water purification	203,839	1,379,333	(2)	(2)
Other uses [3]	407,722	2,686,563	(2)	(2)
Total chemical	1,592,321	10,344,180	1,988,000	12,651,000
Refractory lime (dead-burned dolomite)	455,258	3,785,834	557,000	4,693,000
	[4] 2,987,133	[4] 21,748,655	3,783,000	27,464,000
Hydrated lime (included in above totals)	1,005,619	7,939,513	1,216,000	9,700,000

[1] Subject to revision.
[2] Included in total chemical.
[3] Details of distribution shown in table on p. 1245.
[4] Includes 143,716 short tons valued at $750,155, used by producers (captive tonnage).

The following table shows sales of lime by States and uses for 1935. Similar data for 1936 are not yet available.

[2] Bowles, Oliver, and Banks, D. M., Lime: Inf. Circ. 6884, Bureau of Mines, 1936, 37 pp.

Lime sold or used by producers in the United States in 1935, by States and uses

State	Building		Agricultural		Chemical												Total	
					Glass works		Paper mills		Sugar refineries		Tanneries		Metallurgy		Other chemical			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	30,697	$220,291	45	$88			33,445	$208,322	1,625	$9,560			36,061	$205,488	25,284	$159,437	127,157	$803,186
Arizona	(1)	(1)									(1)	(1)	11,397	93,790	(1)	(1)	22,048	227,658
Arkansas	(1)	(1)					(1)	(1)	(1)	(1)					(1)	(1)	(1)	(1)
California	16,368	169,158	2,230	14,512			2,687	22,788	(2)	(1)	(1)	(1)	13,220	129,265	12,736	136,053	49,141	491,549
Colorado	(1)	(1)											(1)	(1)	(1)	(1)	(1)	(1)
Connecticut	(1)	(1)	(1)	(1)			(1)	(1)							(1)	(1)	(1)	(1)
Florida	5,057	46,400	(1)	(1)					(1)	(1)					6,083	54,880	13,572	126,035
Georgia	5,192	40,689															5,192	40,689
Hawaii	323	3,468	17	68					6,375	66,938							6,715	70,474
Idaho	(1)	(1)															(1)	(1)
Illinois	17,077	146,202	(1)	(1)			8,230	46,201			(1)	(1)	35,219	234,075	45,530	366,955	117,602	878,746
Indiana	5,071	35,676	1,066	7,465	(1)	(1)	14,185	82,728	1,047	9,423	(1)	(1)	12,695	67,983	35,590	225,506	71,883	442,803
Kentucky	(1)	(1)	(1)	(1)											(1)	(1)	(1)	(1)
Louisiana							(1)	(1)	(1)	(1)					(1)	(1)	(1)	(1)
Maine	(1)	(1)	(1)	(1)			(1)	(1)			(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Maryland	(1)	(1)	(1)	(1)													39,528	300,021
Massachusetts	39,862	433,184	4,908	38,042			4,017	31,272	(1)	(1)	3,066	$26,726	(1)	(1)	15,517	108,501	67,969	642,755
Michigan	(1)	(1)	(1)	(1)			(1)	(1)			(1)	(1)	(1)	(1)	4,981	32,608	35,401	260,097
Minnesota	(1)	(1)	(1)	(1)			(1)	(1)			(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Missouri	35,347	263,581	(1)	(1)	(1)	(1)	49,620	264,848	(1)	(1)	(1)	(1)	34,658	161,854	188,994	1,045,722	312,462	1,759,918
Montana	(1)	(1)	(1)	(1)									(1)	(1)	(1)	(1)	(1)	(1)
Nevada	(1)	(1)	(1)	(1)									(1)	(1)	(1)	(1)	(1)	(1)
New Jersey	(1)	(1)	(1)	(1)			(1)	(1)									5,515	42,161
New Mexico	(1)	(1)													(1)	(1)	(1)	(1)
New York	2,835	25,232	7,890	58,145			(1)	(1)	(1)	(1)	3,675	33,524	26,787	192,996	10,407	83,495	59,110	462,363
North Carolina	(1)	(1)	(1)	(1)													(1)	(1)
Ohio	248,230	2,182,697	37,028	252,655	85,993	$603,033	(1)	(1)			(1)	(1)	50,514	264,896	259,029	2,229,735	707,358	5,690,656
Oregon	(1)	(1)	(1)	(1)			(1)	(1)									(1)	(1)
Pennsylvania	58,065	470,385	137,683	902,243	(1)	(1)	40,871	265,070	(1)	(1)	31,565	215,245	101,817	595,610	161,146	1,252,107	531,501	3,703,339
Puerto Rico	(1)	(1)	(1)	(1)					(1)	(1)							4,792	43,226
Rhode Island	(1)	(1)	(1)	(1)	(1)	(1)									(1)	(1)	(1)	(1)
South Dakota	(1)	(1)											(1)	(1)			(1)	(1)

[1] Included under "Undistributed."

Lime sold or used by producers in the United States in 1935, by States and uses—Continued

State	Building		Agricultural		Chemical												Total	
					Glass works		Paper mills		Sugar refineries		Tanneries		Metallurgy		Other chemical			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Tennessee	34,068	$267,910	157	$213	------	------	50,128	$235,284	60	$350	1,889	$11,912	33,830	$146,958	26,490	$152,207	146,622	$814,834
Texas	23,833	227,585	(1)	(1)	(1)	(1)	(1)	(1)	------	------	(1)	(1)	1,451	13,506	12,867	114,796	38,863	362,636
Utah	(1)	(1)	------	------	------	------	------	------	------	------	------	------	10,929	91,317	(1)	(1)	15,957	152,586
Vermont	6,584	50,937	4,312	26,482	------	------	1,194	11,087	------	------	1,397	12,853	906	6,355	22,750	167,078	37,143	274,792
Virginia	34,486	250,148	19,660	116,514	(1)	(1)	5,469	34,506	(1)	(1)	916	5,912	32,652	193,255	40,315	248,723	133,696	850,444
Washington	5,905	83,048	(1)	(1)	------	------	(1)	(1)	------	------	(1)	(1)	(1)	(1)	(1)	(1)	34,471	347,399
West Virginia	16,656	114,063	12,309	67,373	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	150,930	1,024,463	211,904	1,404,037
Wisconsin	20,925	171,115	(1)	(1)	------	------	(1)	(1)	------	------	(1)	(1)	------	------	7,209	95,034	39,324	347,656
Undistributed	50,313	515,033	55,355	418,039	5,721	$38,048	134,685	1,003,049	11,267	97,103	28,874	205,083	50,623	340,071	40,961	354,430	152,207	1,208,545
	656,894	5,716,802	282,660	1,901,839	91,714	641,081	344,531	2,205,155	20,374	183,374	71,382	511,255	452,759	2,737,419	1,066,819	7,851,730	2,987,133	21,748,655

[1] Included under "Undistributed."

Building lime.—Because of limited activity in building during the depression years, sales of building lime were at a low ebb, but they increased substantially in 1935 and 1936. Preliminary figures show sales of 923,000 short tons valued at $7,992,000 in 1936 compared with 656,894 tons valued at $5,716,802 in 1935. Building lime is an important product in Ohio. The following table shows sales in that State from 1933 to 1935.

Lime sold or used by Ohio producers for construction, 1933–35 [1]

	1933		1934		1935	
	Short tons	Value	Short tons	Value	Short tons	Value
Quicklime	1,841	$11,807	2,628	$17,080	2,650	$17,695
Hydrated lime	214,019	1,294,394	183,032	1,472,590	245,580	2,165,002
	215,860	1,306,201	185,660	1,489,670	248,230	2,182,697

[1] Ohio produced 40.5 percent of the total building lime sold by producers in 1933, 36.3 percent in 1934, and 37.8 percent in 1935.

Chemical lime.—The chemical and manufacturing uses of lime have made large gains during recent years. If refractory lime (dead-burned dolomite) is included the total lime so used has increased from 1,663,591 tons in 1934 to 2,047,579 in 1935 and approximately 2,545,000 in 1936. Sales according to the principal chemical uses are shown in the table on page 1242. The following table shows sales of lime in 1935 for minor chemical uses that are designated "Other uses" in the previous table.

Chemical lime sold or used by producers in the United States for "Other uses" in 1936

Use	Short tons	Value	Use	Short tons	Value
Acid neutralization	4,344	$38,902	Oil and fat manufacture	20,460	$154,264
Alkali works (ammonia, soda, potash)	18,133	94,524	Paint (calcimine, whitewash, varnish, etc.)	14,707	96,944
Bleach, liquid	10,741	71,965	Polishing and buffing	3,103	63,866
Calcium acetate	3,500	20,035	Rubber	2,627	20,838
Calcium carbide	52,535	267,791	Salt refining	5,942	32,928
Coke and gas manufacture (gas purification and plant by-products)	20,914	140,026	Sand-lime brick	11,400	72,191
			Silica brick	9,116	67,755
			Soap	8,650	44,035
Food products	7,357	44,579	Tobacco curing	3,711	18,578
Gelatin (edible)	4,195	27,962	Wood distillation	4,265	30,060
Glue	7,213	50,941	Undistributed [1]	28,669	198,144
Insecticides (spraying materials)	38,428	312,474	Unspecified	122,747	786,401
Magnesia works	4,965	31,360		407,722	2,686,563

[1] Lime used in alcohol manufacture, asphalt filler, bichromates, bituminous concrete materials, bromine, calcium carbonate, calcium gluconate, cement, cinder blocks, corn products, cream of tartar, creameries and dairies, disinfectants (chloride of lime, etc.), dyes, explosives, flour mills, iron oxide, lubricants, magnesium oxide, oxygen purification, potassium citrate, retarder, sanitation, slag cements, sodium citrate, soil erosion, sulphur, textiles, and whiting.

Agricultural lime and other liming materials.—Sales of lime for agriculture fluctuate less than for other major uses. In 1934, 222,077 short tons were sold; in 1935, 282,660 tons; and in 1936, approximately 315,000 tons. Materials used for liming land include quicklime, hydrated lime, lime from oyster shells, crushed oyster shells, raw pulverized limestone, and calcareous marl. The following table shows sales of these products in 1935 and 1936.

Agricultural lime and other liming materials sold by producers in the United States, 1935-36, by kinds

Kind	Short tons		Value	
	Gross	Effective lime content [1]	Total	Average
1935				
Lime from limestone:				
Quicklime	84,943	71,600	$464,603	$5.47
Hydrated	197,717	130,500	1,437,236	7.27
Lime from oyster shells [2]	16,258	13,700	102,593	6.31
Oyster shells (crushed)[2]	44,145	21,300	106,609	2.41
Limestone	2,140,370	921,000	2,656,728	1.24
Calcareous marl	88,062	38,860	96,658	1.10
1936 [3]				
Lime from limestone:				
Quicklime	94,000	79,000	518,000	5.51
Hydrated	221,000	146,000	1,610,000	7.29
Lime from oyster shells [2]	9,802	8,300	72,134	7.36
Oyster shells (crushed)[2]	68,232	32,900	196,498	2.88
Limestone	3,411,000	1,468,000	3,804,000	1.12
Calcareous marl	45,528	20,400	58,682	1.29

[1] Estimated. [2] Bureau of Fisheries. [3] Subject to revision.

Hydrated lime.—Sales of hydrated lime, by uses, in 1935 and 1936 are indicated in the following table:

Hydrated lime sold or used by producers in the United States, 1935-36, by uses

Use	1935		1936 [1]	
	Short tons	Value	Short tons	Value
Agricultural	197,717	$1,437,236	221,000	$1,610,000
Building	471,051	3,977,204	645,000	5,512,000
Chemical:				
Glass works	1,154	7,792	(2)	(2)
Metallurgy	34,107	249,607	(2)	(2)
Paper mills	30,184	216,601	(2)	(2)
Sugar refineries	12,627	116,359	(2)	(2)
Tanneries	32,112	234,558	(2)	(2)
Water purification	102,675	774,396	(2)	(2)
Other uses	123,992	925,760	(2)	(2)
Total chemical	336,851	2,525,073	350,000	2,578,000
	1,005,619	7,939,513	1,216,000	9,700,000

[1] Subject to revision. [2] Included in total chemical.

TRENDS IN PRINCIPAL USES

Figure 95 shows trends in the principal uses of lime from 1915 to 1936. Total production in 1936 increased more than in any year since the bottom of the depression in 1932. The chief increases from 1932 to 1935 were in chemical lime, but in 1936 the principal gain was in building lime. Trends in the average value per ton and in the number of plants in operation are also shown.

Figure 96 shows the relation between sales of building lime and volume of construction for a 10-year period. A steady gain in this market may be anticipated if the volume of building attains the proportions expected.

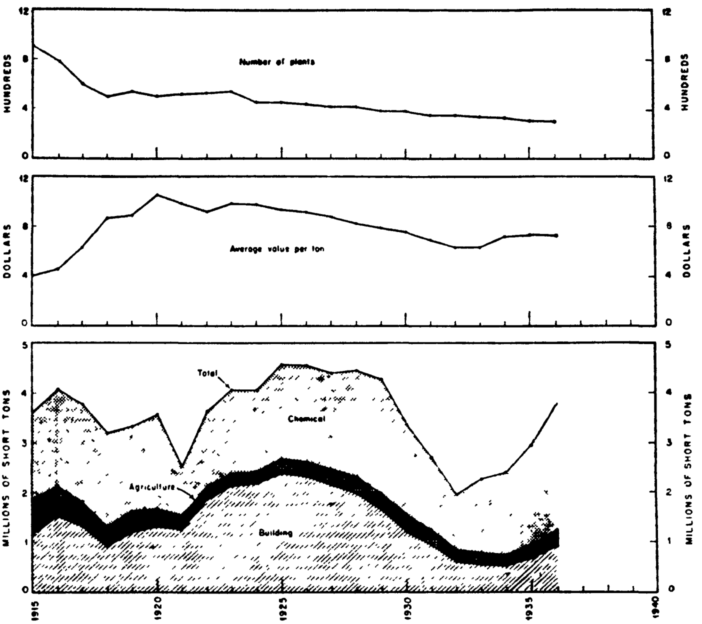


FIGURE 95. Trends in the principal uses of lime, number of plants, and average value per ton, 1915–36

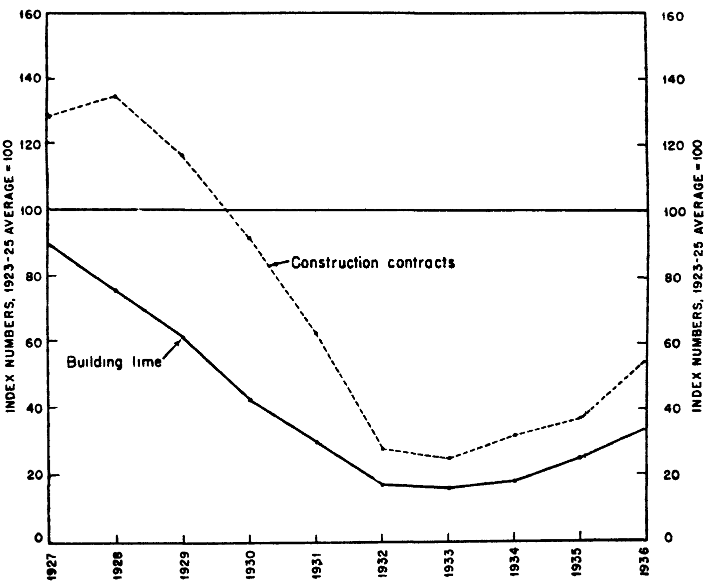


FIGURE 96.—Value of sales of building lime compared with value of construction contracts awarded, 1927-36. To facilitate comparison unlike units have been reduced to percentages of the 1923-25 average. Statistics for lime are from the Bureau of Mines; those for construction compiled by the Federal Reserve Board from data of the F. W. Dodge Corporation.

Figure 97 shows the relation of sales of fluxing and refractory lime (dead-burned dolomite) to output of steel ingots from 1927 to 1936. The remarkable activity of steel plants in 1936 has so fostered this market that sales were at a higher level than in predepression years.

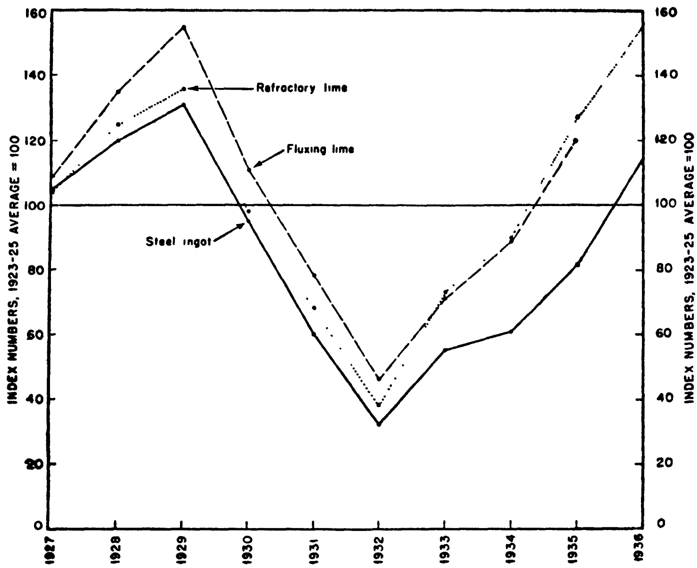


FIGURE 97.—Sales of fluxing and refractory lime compared with steel-ingot production, 1927-36. To facilitate comparison unlike units have been reduced to percentages of the 1923-25 average. Data on production of steel ingots compiled by American Iron and Steel Institute.

NEW DEVELOPMENTS

In May 1936 the Bureau of Mines published Information Circular 6884, entitled "Lime." It covers briefly the history of lime manufacture, raw materials, kinds of lime produced, uses, quarrying and manufacturing methods, and marketing.

A new type of heat- and sound-insulating building material known as microporite has been developed in Europe for interior use. Fine silica dust is mixed with lime and water, molded, and treated with steam for 7 hours. The process is similar to that employed in the manufacture of sand-lime brick, but the reaction is more rapid and complete. The units are strong, although they weigh only 25 to 50 pounds per cubic foot. A large Canadian lime producer is conducting exhaustive research on the manufacture of this product.

Many improvements were made in plant equipment in various parts of the country in 1936. Several lime-putty plants were completed; some of them furnish aged putty, for which certain advantages are claimed.

It has been found that hydration of lime can be accelerated by the addition of small percentages of salts, such as sodium hydroxide.

Experiments conducted in Europe indicate that the hardening and setting of lime mortar are not due primarily to carbonation but to drying and shrinking of the calcium hydroxide gel. Short cycles of partial drying and rewetting increase the strength greatly.

An innovation in the lime industry is the installation by the Chemical Lime Co., Bellefonte, Pa., of a 400-foot rotary kiln. The purpose of the kiln is to obtain slow calcination at a relatively low temperature and to attain a large productive capacity. About 3 hours elapse from the time the limestone enters the kiln until it is discharged as lime, and the maximum temperature attained is about 2,200° F. It is expected that 200 tons of chemical lime will be produced daily.

PRICES

The average value of lime, f. o. b. plant, dropped steadily from 1923 to 1932 when it was only $6.28 a ton. The value remained unchanged in 1933, advanced to $7.16 a ton in 1934, rose to $7.28 in 1935, and remained fairly steady in 1936 at an average of $7.26. The price of agricultural lime increased 3 cents a ton; building lime dropped 4 cents; chemical lime dropped 14 cents; and refractory lime (dead-burned dolomite) rose 11 cents a ton in 1936. The average sales value of hydrated lime at the centers of production rose from $7.90 a ton in 1935 to $7.98 in 1936.

As indicated in figure 95 the average value of lime is still much lower than in 1926. The price index of lime (1926=100) was 78.6 in 1934, 79.9 in 1935, and 79.7 in 1936. The price indexes of all building materials for the same years were respectively, 86.2, 85.3, and 86.7. Therefore, the recovery in prices of lime has not kept pace with that of building materials in general.

FOREIGN TRADE [3]

Imports.—Total imports of lime for consumption in the United States in 1936 were nearly twice as great in quantity and 85 percent greater in value than in 1935. The largest increase was in imports of dead-burned dolomite, the use of which has been stimulated greatly by the high level of activity at steel plants. The following tables show imports for a series of years and imports for 1935 and 1936 by countries:

Lime imported for consumption in the United States, 1932–36

Year	Hydrated lime		Other lime		Dead-burned dolomite		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1932	1,677	$18,756	7,100	$77,279	5,120	$115,808	13,897	$211,843
1933	1,200	11,865	9,305	93,399	6,763	163,081	17,268	268,345
1934	923	8,872	8,309	74,447	6,473	166,912	15,705	250,231
1935	1,030	10,571	3,413	36,032	7,519	189,714	11,962	236,317
1936	1,345	12,212	7,859	74,946	[1] 13,928	[1] 349,678	23,132	436,836

[1] Classification changed in 1936 to "Dead-burned basic refractory material containing 6 percent or mor of lime and consisting chiefly of magnesia and lime."

[3] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Lime imported for consumption in the United States, 1935–36, by countries and districts [1]

Country	District	1935		1936	
		Short tons	Value	Short tons	Value
Austria	New York	2	$81		
Canada	Los Angeles	62	659	702	$7,037
	Maine and New Hampshire	87	1,231	85	1,367
	Oregon			55	462
	San Francisco	1,678	19,180	2,762	29,496
	Vermont	9	88	18	164
	Washington	2,458	22,443	5,227	44,993
Cuba	Florida	87	770	36	320
Germany	New York	20	1,343	234	2,241
	Pittsburgh			(2)	165
Japan	Washington	(2)	3	(2)	8
Mexico	El Paso	1	5	3	25
	San Antonio			32	205
United Kingdom	New York	35	767	50	675
	Philadelphia	4	33		
		4,443	46,603	9,204	87,158

[1] Exclusive of dead-burned dolomite.
[2] Less than 1 ton.

Exports.—Exports of lime are relatively small. The following tables show exports for a series of years and for 1936 by countries of destination:

Lime exported from the United States, 1932–36

Year	Short tons	Value	Year	Short tons	Value
1932	3,579	$56,479	1935	3,927	$63,672
1933	3,710	58,095	1936	4,601	71,109
1934	3,752	60,167			

Lime exported from the United States in 1936, by countries

Country	Short tons	Value	Country	Short tons	Value
North America:			South America:		
Canada	1,494	$18,070	Argentina	14	$579
Central America:			Brazil	11	18
British Honduras	8	178	Chile	14	387
Honduras	1,005	9,501	Colombia	1	31
Nicaragua	45	1,283	Ecuador	158	1,880
Panama	64	1,454	Peru	250	3,383
Salvador	67	881	Uruguay	1	3
Mexico	86	1,977	Venezuela	5	128
Newfoundland and Labrador	40	656	Europe:		
West Indies:			Belgium	1	31
British:			France	17	586
Jamaica	63	784	Sweden	44	1,998
Trinidad and Tobago	28	550	Switzerland	1	16
Other	461	7,958	United Kingdom	12	412
Cuba	91	1,153	Asia:		
Dominican Republic	3	102	Japan	534	16,389
Netherland	75	400	Netherland India	6	249
			Philippine Islands	(1)	22
			Oceania: Australia	2	50
				4,601	71,109

[1] Less than 1 ton.

SHIPMENTS

Total shipments.—Shipments of lime, as reported to the Bureau of Mines by producers, are combined in the following table to show, for 1935, total sales by States, shipments from each State, shipments into each State, probable consumption or supply in each State, and per-capita consumption. The figures in the second table are arranged to show the quantities of lime originating in and destined for State groups that approximately comprise various freight-rate zones. The figures in the second table do not include small quantities produced in Hawaii and Puerto Rico, foreign shipments, or lime for which distribution is not recorded. No account is taken of reshipments beyond the destination indicated when the lime left the producing plant. Similar figures for 1936 are not yet available.

*Lime supplies available fo*r *consumption in continental United States in 1935, by States, in short tons*

State	Sales by producers	Shipments from State	Shipments into State	Supply: Hydrated	Supply: Quicklime	Supply: Total	Supply: Pounds per capita [1]
Alabama	127,157	39,568	14,189	13,325	88,453	101,778	72
Arizona	22,048	8,365	172	1,121	12,734	13,855	72
Arkansas	(2)	(2)	(2)	5,883	8,818	14,701	15
California	49,141	6,415	22,813	18,232	47,307	65,539	23
Colorado	(2)	(2)	(2)	4,235	5,849	10,084	19
Connecticut	(2)	(2)	(2)	8,129	14,379	22,508	26
Delaware			22,755	9,875	12,880	22,755	178
District of Columbia			14,631	13,076	1,555	14,631	49
Florida	13,572		20,068	19,190	14,450	33,640	42
Georgia	5,192	600	23,087	21,923	5,756	27,679	17
Idaho	(2)		(2)	850	1,050	1,900	8
Illinois	117,602	47,887	97,846	50,887	116,674	167,561	43
Indiana	71,883	43,511	67,841	29,320	66,893	96,213	56
Iowa			50,376	13,027	37,349	50,376	40
Kansas			17,783	10,888	6,895	17,783	19
Kentucky	(2)		(2)	11,088	45,146	56,234	40
Louisiana	(2)		(2)	7,506	46,021	53,527	50
Maine	(2)	(2)	(2)	6,580	41,353	47,933	113
Maryland	39,528	12,300	52,405	40,868	38,765	79,633	95
Massachusetts	67,969	53,973	38,368	22,363	30,001	52,364	24
Michigan	35,401	23,116	128,881	38,159	103,007	141,166	61
Minnesota	(2)	(2)	(2)	9,958	16,858	26,816	20
Mississippi			15,539	4,439	11,100	15,539	16
Missouri	312,462	252,314	12,105	35,188	37,065	72,253	37
Montana	(2)	(2)	(2)	6,947	2,020	8,967	34
Nebraska			6,367	4,682	1,685	6,367	9
Nevada	(2)	(2)	(2)	11,721	1,994	13,715	277
New Hampshire			6,940	1,954	4,986	6,940	28
New Jersey	5,515	313	104,767	69,027	40,942	109,969	51
New Mexico	(2)	(2)	(2)	2,084	1,800	3,884	19
New York	59,110	16,611	192,103	117,418	117,184	234,602	36
North Carolina	(2)	(2)	(2)	27,416	29,272	56,688	33
North Dakota			5,672	5,410	262	5,672	16
Ohio	707,358	477,968	126,288	81,919	273,759	355,678	106
Oklahoma			11,789	6,427	5,362	11,789	9
Oregon	(2)	(2)	(2)	1,442	6,989	8,431	17
Pennsylvania	531,501	222,099	168,399	135,944	341,857	477,801	95
Rhode Island	(2)	(2)	(2)	4,501	3,793	8,294	24
South Carolina			11,460	7,999	3,461	11,460	11
South Dakota	(2)		(2)	2,365	3,017	5,382	16
Tennessee	146,622	116,893	9,813	16,605	22,937	39,542	27
Texas	38,863	2,519	1,988	20,985	17,347	38,332	13
Utah	15,957	240	200	3,195	12,722	15,917	62
Vermont	37,143	33,445	329	930	3,097	4,027	21
Virginia	133,696	98,376	43,185	32,956	45,549	78,505	60
Washington	34,471	6,993	757	3,992	24,243	28,235	35
West Virginia	211,904	155,776	101,652	13,031	144,749	157,780	174
Wisconsin	39,324	11,395	44,850	20,908	51,871	72,779	50
Wyoming			1,084	843	241	1,084	9
Undistributed	152,207	61,183	248,040				
	2,975,626	[3] 1,691,860	1,684,542	996,811	1,971,497	2,968,308	47

[1] Based on Bureau of the Census preliminary statement.
[2] Included under "Undistributed."
[3] Includes 7,318 tons of lime exported or unspecified by producers as to destination.

Lime shipped (supply) in continental United States in 1935, by origin and destination of shipments, in short tons

Destination	Illinois, Indiana, Michigan, Ohio			Maryland, New Jersey, New York, Pennsylvania, West Virginia			Connecticut, Maine, Massachusetts, Rhode Island, Vermont			Florida, Georgia, North Carolina, Virginia			Alabama, Kentucky, Louisiana, Tennessee		
	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total
Illinois, Indiana, Michigan, Ohio	164,742	382,826	547,568	4,901	63,292	68,193	100	....	100	927	5,382	6,309	1,902	16,048	17,950
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	111,520	125,702	237,222	240,465	485,667	726,132	19,993	34,201	54,194	16,331	47,410	63,741	....	524	524
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	13,068	1,881	14,949	3,843	30,666	34,509	26,871	60,176	87,047	600	4,797	5,397	....	....	....
Florida, Georgia, North Carolina, South Carolina, Virginia	22,968	1,156	24,124	7,526	7,824	15,350	....	....	....	51,131	26,077	77,208	27,309	55,849	83,158
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	12,961	33,594	46,555	313	103	416	....	....	....	500	....	500	33,935	149,670	183,605
Arkansas, Kansas, Nebraska, Oklahoma, Texas	2,029	464	2,493	....	....	....	....	....	....	....	....	....	15	....	15
Iowa, Minnesota, Missouri, Wisconsin	20,758	33,706	54,464	....	1	1	....	....	....	5	....	5	....	....	....
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	1,745	124	1,869	1,000	....	1,000	....	....	....	....	....	....	....	....	....

Destination	Arkansas and Texas			Minnesota, Missouri, Wisconsin			Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah, Washington			United States		
	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total
Illinois, Indiana, Michigan, Ohio		70	70	27,713	92,715	120,428				200,285	560,333	760,618
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia				10,930	4,428	15,358				399,239	697,932	1,097,171
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont				75	89	164				44,457	97,609	142,066
Florida, Georgia, North Carolina, South Carolina, Virginia		744	744	550	6,838	7,388				109,484	98,488	207,972
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	1,847	15,105	16,952	3,407	15,185	18,592				52,963	213,657	266,620
Arkansas, Kansas, Nebraska, Oklahoma, Texas	27,564	24,000	51,564	19,040	15,598	34,638	217	45	262	48,865	40,107	88,972
Iowa, Minnesota, Missouri, Wisconsin	302	862	1,164	58,016	108,574	166,590				79,081	143,143	222,224
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	180	1,072	1,252	10,145	4,950	15,095	49,367	114,082	163,449	62,437	120,228	182,665

The following table shows shipments of lime to noncontiguous Territories of the United States in 1935 and 1936:

Shipments of lime to noncontiguous Territories of the United States, 1935–36, in short tons [1]

Territory	1935		1936	
	Short tons	Value	Short tons	Value
American Samoa	(2)	$4		
Hawaii	594	9,509	913	$15,846
Puerto Rico	973	11,732	1,095	13,783
Virgin Islands	57	1,227	127	2,637
Wake Islands	(2)	13		
	1,624	22,485	2,135	32,266

[1] Figures compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.
[2] Less than 1 ton.

Hydrated lime.—The following table shows shipments of hydrated lime by destination in 1935. As Ohio is the largest producer, supplying about 29 percent of the total in 1935, the table shows also shipments from Ohio plants into the various regions.

Shipments of hydrated lime from plants in the United States and in Ohio in 1935, by destinations

Destination	From all plants		From Ohio plants		
	Short tons	Distribution (percent)	Short tons	Distribution (percent)	Group total (percent)
Illinois, Indiana, Michigan, Ohio	200,285	19.9	119,892	41.3	59.9
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	399,239	39.7	110,998	38.3	27.8
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	44,457	4.4	13,067	4.5	29.4
Florida, Georgia, North Carolina, South Carolina, Virginia	109,484	10.9	22,967	7.9	21.0
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	52,963	5.3	8,491	2.9	16.0
Arkansas, Kansas, Nebraska, Oklahoma, Texas	48,865	4.8	1,995	.7	4.1
Iowa, Minnesota, Missouri, Wisconsin	79,021	7.9	10,894	3.8	13.8
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	62,437	6.2	1,323	.5	2.1
Undistributed and exports	8,808	.9	321	.1	3.6
	1,005,619	100.0	289,948	100.0	28.8

CLAYS: KAOLIN (CHINA CLAY AND PAPER CLAY), BALL CLAY, FIRECLAY, BENTONITE, FULLER'S EARTH (BLEACHING CLAYS), AND MISCELLANEOUS CLAY

By Paul M. Tyler and R. W. Metcalf

SUMMARY OUTLINE

In 1936 the production and sales of domestic kaolin broke all previous records, and sales of merchant clay generally continued their upward trend. More domestic clay was exported than in any earlier year, and although imports of china clay and certain other kinds of clay were slightly greater than in 1935, they were far less than in predepression years. Prices were unchanged or only slightly higher, but, owing to larger-scale operations, the industry as a whole enjoyed a prosperous year. Improvement was most marked in the production of higher-grade clays. The heavy-clay-products industries and even the industries using fire clays have so far failed to recover all the ground they lost after 1929, although their condition has improved sharply from the extreme depression of 1932. The pottery industry, too, has failed to regain its former importance, and several other ceramic industries have lagged behind the general recovery, which partly explains the much reduced consumption of sagger clays. More clay was used in making firebrick in 1936 than in any previous year, according to the Bureau of Mines records, and the refractories industries as a whole were in healthy condition. The most spectacular increase was in the use of domestic clay in paper making, sales to that industry having been almost 40 percent greater in 1936 than in 1930, the former record year. The consumption of clay by the rubber industry, which only recently has become an important buyer of such material, increased to an even greater extent, though not so significant from a tonnage standpoint, accounting for almost twice as much clay in 1936 as it did before 1933.

High lights in the following summary table, which compares prewar, predepression, and recent years, are the general rise in domestic production and exports and the decline of imports.

Salient statistics of the clay industry of the United States, 1909–13 and 1925–36

	1909–13 (average)	1925–29 (average)	1930–34 (average)	1935	1936
Domestic clay sold by producers:					
Kaolin, china clay .... short tons..	132,114	453,618	431,932	523,656	638,939
Ball clay .... do....	63,371	116,127	70,299	96,260	101,324
Fireclay and stoneware clay .... do....	1,771,667	2,898,576	1,487,364	1,938,391	2,471,575
Bentonite .... do....	(1)	(1)	118,120	191,133	291,625
Fuller's earth .... do....	35,663	261,640	259,354	227,745	230,814
Miscellaneous clays .... do....	[1] 414,814	[1] 575,708	272,615	174,030	278,965
Total domestic: [2]					
Quantity .... do....	2,417,629	4,305,669	2,639,684	3,151,215	4,013,242
Value	$4,067,229	$17,568,812	$10,977,776	$13,054,152	$15,688,434
Imports:					
Kaolin, china clay .... short tons..	261,266	339,014	140,888	125,963	139,797
Common blue, Gross Almerode short tons..	19,763	12,130	11,306	15,552	32,166
Fuller's earth .... do....	17,060	8,118	4,708	2,935	2,733
Other clays .... do....	33,259	61,048	24,713	31,941	21,183
Total imports:					
Quantity .... do....	331,348	420,310	181,615	176,391	195,879
Value	$2,006,823	$3,841,462	$1,595,101	$1,672,814	$1,896,642
Exports:					
Fireclay .... short tons..	(3)	55,316	39,709	49,949	65,874
Other clay [4] .... do....	(3)	54,028	68,978	101,524	90,569
Total exports:					
Quantity .... do....	(3)	109,344	108,687	151,473	156,443
Value	(3)	$1,217,769	$1,323,744	$1,865,069	$1,844,038

[1] Sales of bentonite included under "Miscellaneous clay" before 1930.
[2] Includes fuller's earth, previously reported in a separate chapter in Minerals Yearbook or Mineral Resources volumes.
[3] Statistics of exports of clay not separately recorded before 1916.
[4] Includes fuller's earth.

CLASSIFICATION

The industrial uses of clays differ almost as much as do their chemical and physical attributes. For a decade or more, the Bureau of Mines clay-production statistics have represented chiefly clay mined and sold as clay, mined under royalty, or shipped into another State for fabrication. In effect, this classification includes most of the high-grade kaolins, ball clays, slip clays, and bentonites used for fine ceramic wares, paper making, and general industrial purposes, plus a considerable part of the fireclays used in the manufacture of refractories and most of the fireclays used for other purposes. It excludes most of the clays and shales used in making common brick, sewer pipe, and other heavy-clay products or in cement manufacture. The present chapter in general follows this same classification, except that it includes also fuller's earth, formerly discussed in a separate chapter of Minerals Yearbook.

Most clays have the property of bleaching oil to a greater or less extent, hence fuller's earth is merely a clay that is used commercially in the raw state for decolorizing or bleaching oils and fats. Certain other clays, notably bentonite, develop this property to an even higher degree when treated with acid, but earth so activated is not classed by the Bureau of Mines as fuller's earth, even though used for much the same purposes.

The term "clay" includes a great variety of substances that may differ widely in chemical, mineralogical, and physical properties. Virtually all clays comprise a number of minerals. Even pure kaolinite ($Al_2O_3.2SiO_2.2H_2O$), which is ordinarily considered to be the

typical "clay substance", recently has been found to exist as three distinct minerals, and each of these in turn exhibits variations in particle size and other physical attributes. In addition to the kaolin minerals and other relatively simple aluminum silicates, almost all clays contain quartz, feldspar, and mica with varying amounts of organic matter and, in addition, other impurities—such as iron, manganese, and titanium oxides—that may discolor them sufficiently to render them unfit for certain important uses. The white clays are generally the purest, but no two are really alike, and great care must be exercised to maintain a reasonable uniformity in successive shipments, even from the same deposit. Defloculation and sedimentation processes, which hitherto have represented the best clay-washing practice, are inadequate for any but size separations; but improved technique, including the application of froth flotation, may permit commercial fractionation and recombination of natural clays from different banks so as to yield well-standardized products. Under these circumstances, the various rule-of-thumb classifications of clays that have developed may lose their significance. Already the Bureau of Mines, in cooperation with the Tennessee Valley Authority and private clay companies, has devised methods for manufacturing from domestic clays a uniform reproducible product of high-grade kaolin equal to the best Czechoslovak porcelain clay. To develop markets for local clay, the Tennessee Valley Authority has laid the foundations of a ceramic industry in the South that for the first time will use electrically-heated kilns for making pottery. At Boulder Dam, the Bureau of Mines likewise has demonstrated the feasibility of firing pottery products electrically so as to afford outlets for local clays in that vicinity.

DOMESTIC PRODUCTION

China clay or kaolin.—The production of kaolin or china clay jumped to 638,939 short tons valued at $4,537,738 in 1936 compared with a previous high record of 533,800 tons valued at $3,893,814 in 1930. Georgia as usual was the leading producer, contributing 66 percent of the total; South Carolina was second with 20 percent; and Pennsylvania is the only other State that produced as much as 5 percent of the total, although its output is considerably less valuable than that of Florida, which does not produce the cheaper grades of kaolin. The dominance of Georgia is exaggerated somewhat by the inclusion since 1931 of certain hard or so-called "flint" kaolins as kaolin rather than, according to use, as fireclay. Accordingly, a break-down of the Georgia figures is submitted in an accompanying table.

Increased sales in 1936 were well distributed among consuming industries, of which the paper industry is most important, as it accounts for about two-thirds of the total sales of this class of clay. The rubber and ceramics industries, each of which takes about 15 percent of total sales, also were more prosperous in 1936. Larger and larger quantities of clay are going into paint and miscellaneous products. In the paper industry the use of calcium carbonate sludge has increased substantially, but the use of clay, more especially of domestic clay, has increased even more. Improvement in demand for paper clays in 1936 was accelerated by a relatively large increase in book-paper requirements by the large magazines. Most periodicals of the class that use high-grade paper increased their bulk as well as their circulation as a result of an increase in advertising by companies

having a Nation-wide distribution of their products. Moreover, larger percentages of clay are being used in such papers; instead of an average content of 7 percent ash, as formerly, many book papers now have an ash content of 14 to 20 percent, occasionally higher. Then, too, foreign clays have been displaced largely by domestic clays, except in certain localities where freight rates are unduly disadvantageous to American miners; and talc, which was used a great deal 20 years ago, likewise is employed only where it has an overwhelming advantage in delivered cost. By active research the quality of domestic clays has been improved progressively, and new varieties have been developed. American clays, formerly used as additions to the beaters (filling), are gaining ground rapidly in the coating field, for which processed clays costing $30 and even $60 a ton are now available. Some of these high-priced clays may replace much of the satin white employed in high-grade coated paper, with an indicated saving in casein consumption.

Kaolin sold by producers in the United States, 1934–36, by States

State	1934		1935		1936	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama					(1)	(1)
California	1,572	$12,229	3,560	$35,789	5,772	$53,053
Delaware	2,127	28,718	(1)	(1)	(1)	(1)
Florida	(1)	(1)	(1)	(1)	(1)	(1)
Georgia	284,556	1,621,223	339,658	2,346,977	419,395	2,895,878
Illinois			(1)	(1)		
Maryland					(1)	(1)
Missouri	(1)	(1)	(1)	(1)	(1)	(1)
North Carolina	7,146	106,742	8,162	118,972	8,657	126,353
Pennsylvania	22,219	67,779	30,478	97,322	42,370	138,962
South Carolina	90,794	658,905	113,586	859,510	128,199	965,183
Vermont	(1)	(1)				
Virginia	(1)	(1)	(1)	(1)	(1)	(1)
Washington	50	250				
Undistributed	17,871	203,170	28,212	306,698	34,546	358,309
	426,335	2,699,016	523,656	3,765,268	638,939	4,537,738

[1] Included under "Undistributed."

Georgia kaolin sold by producers, 1932–36, by uses

Year	China clay, paper clay, etc.			Refractory uses			Total kaolin		
	Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton		Total	Average per ton
1932	207,519	$1,148,000	$5.53	26,725	$48,988	$1.83	234,244	$1,196,988	$5.11
1933	239,271	1,342,512	5.61	40,767	75,108	1.84	280,038	1,417,620	5.06
1934	236,606	1,535,046	6.49	47,950	86,177	1.80	284,556	1,621,223	5.70
1935	298,275	2,251,785	7.55	41,383	95,192	2.30	339,658	2,346,977	6.91
1936	367,463	2,764,065	7.52	51,932	131,813	2.54	419,395	2,895,878	6.90

Ball clay.—Ball clays are highly plastic, strong, and white to cream in color. Geologically they represent the finest of the pure clay substance that remains suspended for the longest time in lakes or swamps; often they contain a little lignite. Toughness is a characteristic

property, and the presence of adsorbed salts or electrolytes is indicated. Ball clays also differ from kaolins in that their average particle size is measurably smaller. Domestic ball clay is mined principally in Kentucky and Tennessee, although minor amounts so classed are produced in New Jersey, Maryland, Missouri, and Illinois. They are used chiefly in white earthenware and porcelain but are employed also in floor and wall tile, electrical porcelains, certain glass refractories, and graphite crucibles, chiefly mixed with china clay in the body as a bonding agent and to impart plasticity and, in refractory mixes, to make them workable. Brief descriptions of the Tennessee-Kentucky ball-clay operations have been published recently.[1]

Ball clay sold by producers in the United States, 1934–36

State	1934		1935		1936	
	Short tons	Value	Short tons	Value	Short tons	Value
Illinois	(1)	(1)	(1)	(1)	(1)	(1)
Kentucky	29,398	$216,684	44,971	$305,687	56,006	$388,235
Maryland	(1)	(1)	(1)	(1)	(1)	(1)
Missouri	(1)	(1)	(1)	(1)	(1)	(1)
New Jersey	1,537	11,202	7,226	33,933	10,135	51,277
Tennessee	23,587	151,808	34,498	203,741	27,504	209,357
Undistributed	8,355	43,727	9,565	60,404	7,679	47,046
	62,877	423,421	96,260	630,765	101,324	695,915

[1] Included under "Undistributed."

Slip clay.—Slip clays are fine-grained and somewhat similar to ball clays, except that they contain a high percentage of iron and manganese, so that they melt to greenish or brown glass at relatively low temperatures. The use of slip clays for glazing stoneware is decreasing, as they are being displaced for this purpose by artificial white glass. So-called slip clays are mined in the United States only in New York, Pennsylvania, and (occasionally) Michigan. The quantity has become quite small, in recent years rarely exceeding 5,000 tons annually. Although separately reported by the Bureau of Mines in previous years, henceforth they will be included in the classification "miscellaneous clays." At present they are employed principally for binding abrasive wheels, although minor quantities are still used for glazing pottery, tile, and other fired products.

Fireclay.—Fireclays withstand high temperature and usually are not fusible below about 3,000° F. (cone 27 or 28). In collecting statistics, the Bureau of Mines will attempt later to distinguish between (*a*) plastic fireclays, (*b*) flint clays, and (*c*) high-alumina or burley clays. Although the main use of fireclays is for refractories of various kinds, chiefly firebrick, many of the miners of these clays find markets for a portion of their output in other industries, including some purposes for which other kinds of clay might be equally suitable. On the other hand, certain kinds of kaolin, notably the hard or flint kaolins of Georgia and Pennsylvania, are used in refractories, as are also small quantities of bentonites and other clays. In short, the term "fireclay" is employed rather loosely and is not confined strictly to refractory

[1] Tennessee Valley Authority, Clay Resources of the T. V. A. Region: Division of Geology, Bull. 4, Knoxville, Tenn., October 1936, pp. 28–30.
Bell, Richard, A Modern Ball-Clay Operation: Am. Inst. Min. and Met. Eng., paper presented at September 1936 meeting, Industrial Minerals Division.
Carothers, Richard B., Preparation of Ball Clays: Bull. Am. Ceram. Soc., vol. 16, no. 3, 1937, p. 96.

clays, nor does it include all clays used in making refractories. In the present review stoneware clays, formerly reported separately, are included in the Bureau of Mines figures with fireclay. For 1936, moreover, the schedule employed for reporting production was altered to indicate more definitely what clay was used at the plant where it was produced and what clay was sold or shipped elsewhere. This change, too, tends to make the figures not quite comparable with those of former years.

Although fireclay occurs in all but about a dozen States and is mined in at least 30, Pennsylvania, Ohio, Missouri, Kentucky, and California together contribute over 75 percent of production, about one-third of the total coming from Pennsylvania alone.

Fireclay and stoneware clay sold by producers in the United States, 1934-36, by States

State	1934		1935		1936	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	33,916	$45,284	35,466	$57,278	66,352	$85,827
California	75,907	169,492	109,782	255,027	167,295	326,366
Colorado	30,601	43,599	33,227	49,628	54,433	78,567
Illinois	68,717	149,238	98,280	275,268	124,806	271,006
Indiana	31,543	44,806	51,151	69,265	36,572	63,166
Kentucky	111,444	390,019	187,826	475,523	181,345	470,020
Maryland	11,408	42,545	8,016	38,952	21,429	72,314
Missouri [1]	222,403	957,349	267,523	999,953	471,546	1,331,432
New Jersey	63,384	269,902	66,651	321,354	87,294	473,060
Ohio	203,682	465,800	317,037	662,406	406,896	860,236
Pennsylvania	412,412	1,043,898	683,321	1,679,817	733,049	1,741,633
Tennessee	16,550	56,175	16,766	59,755	19,069	71,846
Texas	19,907	38,694	7,146	24,486	6,394	57,071
Washington	3,328	3,108	3,607	5,794	17,137	51,570
West Virginia	28,658	51,250	38,670	70,654	55,767	99,709
Other States	11,727	62,153	13,922	66,473	22,191	81,741
	1,345,587	3,833,312	1,938,391	5,111,633	2,471,575	6,135,564

[1] Includes diaspore and burley clay as follows: 1934, 20,294 tons, valued at $104,692; 1935, 23,248 tons, valued at $104,316; 1936, 33,584 tons, valued at $150,455.

Stoneware clay.—Stoneware clays are produced principally in Ohio and Illinois and are used not only for stoneware but also for yellow ware, art ware, earthenware, and even for terra cotta. The classification obviously is arbitrary and overlaps that for fireclay. The ideal stoneware clay has a long vitrification range and vitrifies at a lower temperature than does ordinary fireclay, but these requirements along with the desired plasticity, toughness, and bonding strength, are generally obtained by mixtures of different clays, including plastic fireclay, flint fireclay, and more or less ball clay. Actually, more "fireclay" than "stoneware clay" has been used in making chemical and other stoneware, and the quantities classified by the producers as "stoneware clay" in their reports to the Bureau of Mines have diminished greatly during the last several years. After review of these facts, the classification has been eliminated from certain tabulations in this chapter, and clay that formerly would have been so designated has been included under the broader classification "fireclay."

Bentonite.—Bentonites are "soapy" clays composed of weathered and altered volcanic ash. They are characterized by an extraordinary capacity to take up many times their own volume of water (adsorption). Their chief use is for oil-well drilling muds to maintain

suspensions, but their thickening and suspending properties are utilized in many other industries, and substantial quantities are employed in foundries for rejuvenating molding sand and as a core wash. Most of the activated earths employed for bleaching oils are acid-treated bentonites. Another use of great practical importance, though not constituting a regular outlet for much tonnage, is for sealing dams and for rendering water-bearing gravels and seamy rock impervious. Probably the most typical bentonite is found near Belle Fourche, S. Dak., and in an adjoining area in eastern Wyoming, although it occurs in at least a dozen States, and commercial shipments were reported in 1936 from 8 States.

Bentonite sold by producers in the United States, 1934-36, by States

State	1934		1935		1936	
	Short tons	Value	Short tons	Value	Short tons	Value
Arizona	(1)	(1)	(1)	(1)	(1)	(1)
Arkansas			(1)	(1)		
California	108,924	$291,857	63,184	$215,315	[2] 126,112	[2] $344,624
Mississippi					(1)	(1)
Oklahoma	6,529	73,156	4,805	58,508	(1)	(1)
South Dakota	(1)	(1)	8,923	40,001	(1)	(1)
Texas	35,248	235,194	39,391	237,123	22,647	154,216
Utah	(1)	(1)	(1)	(1)	(1)	(1)
Wyoming	27,161	246,548	34,415	350,846	55,090	520,852
Undistributed	37,477	203,823	40,415	184,551	87,776	547,489
	215,339	1,050,578	191,133	1,086,344	[2] 291,625	[2] 1,567,181

[1] Included under "Undistributed".
[2] Includes output of "rotary mud" in California, amounting to 95,043 tons, valued at $175,967.

Fuller's earth.—The production and consumption of fuller's earth in the United States increased in 1936, but the increase was small compared with that in petroleum refining. The only State to show an important expansion in production was Texas; output in several other States declined. The aggregate production was 230,814 tons valued at $2,264,978; and the indicated consumption, as calculated by adding imports and deducting exports, rose 2 percent to 227,429 tons compared with 222,520 tons in 1935. The Federal Reserve Board index of petroleum refining, however, jumped more than 10 percent, the yearly average of 181 exceeding the previous record of 168 in 1929 by a wide margin, whereas the apparent quantity of fuller's earth used was 25 percent less than in 1929 and 31 percent less than in 1930, when it reached its maximum of 328,642 tons.

Over 90 percent of the domestic fuller's earth sold is used for refining petroleum products; 5 to 7 percent is used for clarifying, bleaching, decolorizing, or filtering animal and vegetable oils; and an almost negligible amount, in some years less than 1 percent, is used for miscellaneous purposes. The statistics show quite positively that consumption of fuller's earth in the United States has not kept pace with the growth of the petroleum industry in recent years. To be sure, there is no really accurate barometer of the potential demand for fuller's earth or the amount of decolorizing that has to be done, because no data are available as to the proportion of possible lubricants removed at lubricating-oil refineries, where most of the fuller's earth is used. Nevertheless, the fact remains that relative quantities of fuller's earth have diminished since 1930—whether the comparison is

made on the basis of crude-oil production, deliveries to refineries, or lubricant production. The obvious conclusion is that much of the expanded consumption of artificially activated earths, made from bentonite, and of acid-sprayed earths, such as are produced especially in Texas, have invaded the market for fuller's earth. New methods of oil refining likewise have threatened to diminish the use of fuller's earth, but inquiries in the trade lead to the conclusion that chemical processing of lubricating oils may have been overdone and that even oils so processed generally require some treating with fuller's earth. There is a feeling, too, that the recent trend away from percolation methods and in favor of contact methods may be now in reverse, a fact of importance to the fuller's-earth industry, inasmuch as the finer grades used in contact refining sell for only about $6.50 a ton as against $10 to $12.50 a ton for coarser grades such as are used for percolation.

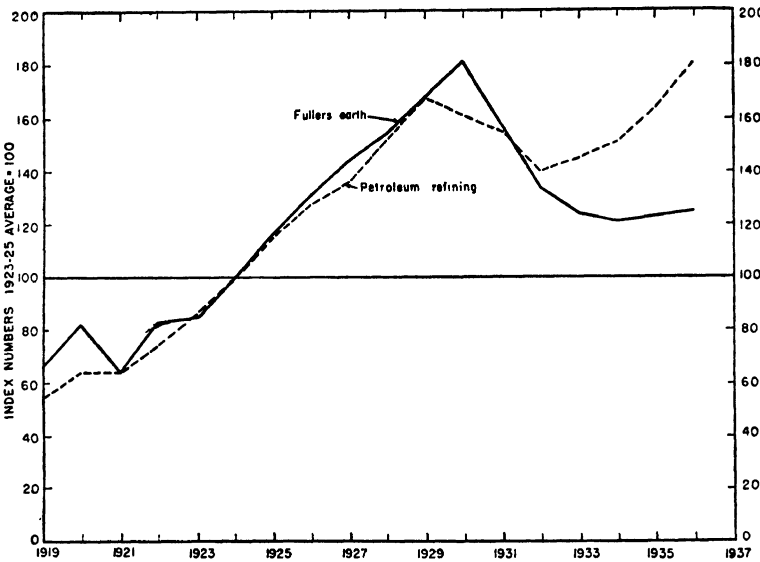


FIGURE 98.—Consumption of fuller's earth compared with petroleum refining activity, 1919–36. To facilitate comparison the tonnage of fuller's earth has been reduced to percentages of the 1923–25 average. The petroleum-refining index is compiled by the Federal Reserve Board.

Progress is being made in finding uses for spent earth. It may be too much to expect that earth will be thrown away after being used only once, but if the spent earth could be disposed of profitably there would be less incentive for revivifying it after its efficiency had been impaired substantially. For about 5 years a leading California cement company has been making a weatherproof portland cement by adding to the clinker before grinding about 3 percent of spent clay containing 20 to 30 percent carbonaceous matter. The process (U. S. Patent 1755638) yields a cement that is at least as strong as ordinary portland cement, although it does not mature so rapidly additional uses for spent earth have been noted by Kauffman.[2]

[2] Kauffman, H. L., New Uses for Spent Fuller's Earth: Nat. Petrol. News, vol. 27, no. 52, Dec. 25, 1935, pp. 25–28; and vol. 28, no. 1, Jan. 1, 1936, pp. 21, 22, 24.

Fuller's earth sold by producers in the United States, 1934–36, by States

State	1934		1935		1936	
	Short tons	Value	Short tons	Value	Short tons	Value
Florida and Georgia	148, 319	$1, 407, 380	145, 236	$1, 491, 764	139, 376	$1, 426, 346
Texas	32, 763	325, 397	40, 925	391, 641	46, 855	462, 656
Other States [1]	39, 182	352, 304	41, 584	346, 824	44, 583	375, 976
	220, 264	2, 085, 081	227, 745	2, 230, 229	230, 814	2, 264, 978

[1] 1934: Alabama, Colorado, Illinois, Indiana, and Nevada; 1935: Colorado, Illinois, Indiana, Nevada, and New Jersey; 1936: California, Colorado, Illincis, Indiana, Massachusetts, Nevada, and New Jersey.

Miscellaneous clay.—Except for slip clay, which appears in the miscellaneous group this year for the first time, the material included in this group by the Bureau of Mines consists chiefly of shale and common clays of low unit value and used mostly for making sewer pipe, common brick, and other heavy-clay products. Most clays of this class do not find their way into the Bureau of Mines statistics because they are fabricated at integrated plants. Only under certain circumstances can these clays be transported economically more than a very short distance from the pit from which they are dug. This classification should not be interpreted as representing "all other clays" produced in the United States but not included under more specific designations. In addition to clays made locally into heavy-clay products or used in cement manufacture, the Bureau of Mines statistics exclude, also, ochers, umber, and other colored clays and earths used as pigments.

The geographical distribution of this group of clays is shown in the following table.

Miscellaneous clay, including slip clay and shale, sold by producers in the United States, 1934–36

State	1934		1935		1936	
	Short tons	Value	Short tons	Value	Short tons	Value
California	19, 531	$27, 218	23, 982	$22, 400	35, 334	$39, 516
Colorado	8, 814	8, 875	23, 142	19, 267	53, 381	47, 643
Indiana	35, 702	33, 323	15, 657	11, 646	12, 980	10, 593
Pennsylvania	15, 293	15, 100	21, 401	21, 767	43, 211	109, 228
Washington	14, 323	11, 002	4, 950	4, 397	26, 831	52, 920
Other States	43, 462	95, 408	84, 898	150, 436	107, 228	227, 158
	137, 125	190, 926	174, 030	229, 913	278, 965	487, 058

Heavy-clay products.—Employment in brick, tile, and terra-cotta works in the United States rose sharply in the early months of 1936 but failed to advance much beyond 50 percent of the 1923–25 average, the index for the 12-month period being 45.6 compared with 36.3 for 1933, an increase of 25 percent.

Production statistics for heavy-clay products are compiled by the Bureau of the Census, which reported that in 1935 the value of all clay products, exclusive of pottery and nonclay refractories, made in the United States was $89,989,246 compared with $66,179,814 in 1934 For common brick alone the value rose from $11,419,108 to $18,246,059 reflecting a volume increase from 1,099 millions in 1934 to 1,806 millions in 1935. For clay firebrick the value rose from $15,485,175 to $19,-496,590 and the quantity from 390 to 482 millions. Corresponding

figures for 1936 have not been compiled, but available data indicate that increases from 1935 to 1936 were even greater than from 1934 to 1935—though still far below the predepression totals, due to the continued lag of building activity behind the recovery in general business.

FOREIGN TRADE [3]

Imports.—Kaolin or china clay comprises the bulk of the clays imported into the United States. These clays come principally from England, although small quantities are imported from Germany and other countries. Notwithstanding a substantial increase in imports in 1936, the amount of foreign clay used in the United States today is scarcely 40 percent of the average annual imports from 1925 to 1929. Compared with pre-war averages, imports of china clay in 1936 had been virtually halved, whereas domestic production was more than four times as large. The next largest item in the import statistics is "common blue and ball clays", imports of which were reported separately in 1936 for the first time and amounted to 30,021 short tons valued at $271,359. These clays likewise come principally from England, and the importations obviously increased in 1936, reflecting greater activity in tile and sanitary ware plants. Formerly included in the same category were Gross Almerode glass-pot clays, a well-known German product, imports of which in 1936 amounted to 2,145 short tons valued at $26,852. Gross Almerode clay has a low shrinkage, high binding power, and high refractoriness; but one of its chief claims to superiority is the ease with which it disintegrates in water and the remarkable uniformity with which water distributes itself through the mass. The composition of some of these clays closely resembles that of china clay, except for an iron oxide content of about 2 percent. Most samples, however, also contain about 1 percent lime.

English ball clays are still preferred by some potters to American clays of this class. They have a much lower melting point, as a class, than the Kentucky-Tennessee ball clays.

Fuller's-earth imports have followed a general downward trend since 1914 and declined further in 1936. Virtually all are from the United Kingdom.

Fuller's earth and clay imported for consumption in the United States, 1934–36

	1934		1935		1936	
	Short tons	Value	Short tons	Value	Short tons	Value
Fuller's earth:						
Unwrought or unmanufactured	34	$406	137	$1,873	71	$960
Wrought or manufactured	4,278	53,145	2,798	35,350	2,662	34,050
	4,312	53,551	2,935	37,223	2,733	35,010
Clays or earths, artificially activated with acid or other material	3,867	232,664	3,589	212,036	3,149	171,049
Kaolin or china clay	100,775	752,993	125,963	959,821	139,797	1,110,780
Common blue and Gross Almerode glass-pot clay	9,467	111,828	15,552	165,560	[1] 32,166	[1] 298,211
All other clays:						
Unwrought or unmanufactured	11,678	120,738	24,488	220,382	9,342	110,436
Wrought or manufactured	5,359	123,301	3,864	77,792	8,692	171,156
Grand total	135,458	1,395,075	176,391	1,672,814	195,879	1,896,642

[1] Imports of Gross Almerode clay reported separately in 1936—2,145 tons valued at $26,852.

[3] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Exports.—Kaolin, ball clay, glass-pot clay, common fire clay, and fuller's earth are the only crude clays that enter international trade to any extent. For many years, fire clay was the only American clay exported regularly in large tonnages, and it still is the only clay for which separate export statistics are compiled by the Bureau of Foreign and Domestic Commerce. In earlier years, the other high-grade clays were chiefly imported and domestic producers, having difficulty in gaining markets even in their own country, made little effort to seek foreign markets.

Following the better standardization and general improvement in quality of American clay, this condition has been changed. Beginning in 1923, the Bureau of Mines has been able to report exports of fuller's earth from returns furnished directly by producers, and in 1936 replies to its questionnaires indicated substantial exports of bentonite, ball clay, slip clay, and even kaolin. Strange as it may seem, in view of the extensive imports of china clay from these countries, American kaolin was shipped in 1936 even to England and Germany, though not, of course, in large amounts.

Fire clays are exported to Canada, Europe, and South America. Domestic clays of this class are of good quality and some of the deposits are relatively close to the Atlantic seaboard. Whereas the average value of domestic fire clay, f. o. b. mines, in 1936 was $2.48 a ton, the export valuation was $6.64 a ton. The latter figure may include freight to port of shipment but, even so, the spread is sufficient to indicate a considerable proportion of processed clay.

The Bureau of Mines returns do not account for the relatively large quantities of unspecified clays reported in the Bureau of Foreign and Domestic Commerce export statistics shown in the Salient Statistics table earlier in this chapter. This is probably due to the fact that much of this business is handled through dealers or custom grinding mills. Nevertheless, the returns from producers tend to show that bentonite enjoys the most widely diversified foreign markets; Canada is the principal consumer, but small shipments are made to Europe, South America, and the Far East. Exports of fuller's earth declined in 1936; Canada and Germany are the leading consumers, but smaller shipments were reported to U. S. S. R. (Russia), Mexico, South American countries, and Cuba.

PRICES

Prices of clay were generally firmer in 1936, although the calculated average sales realization for domestic kaolin dropped slightly to $7.10 compared with $7.19 per ton in 1935. Trade-journal quotations remained virtually unchanged. According to the Engineering and Mining Journal, South Carolina and Georgia china clay was worth $6 to $7 a ton, crushed, pulverized, or air-floated, and $7.50 to $8.50 a ton, water-washed, f. o. b. mines in bulk; $2.50 extra was charged for shipment in 50-pound paper bags. Both grades of Florida clay (super-white and super-plastic), washed and crushed, were $11.75 a ton; Delaware clays $14 a ton; New Jersey plastic kaolin, pulverized, in paper bags, was $10; and Pennsylvania clay, crude, ground, was $6 a ton, f. o. b. mines. For bentonite, f. o. b. Wyoming mines, the quotation was $8 in bulk and $10 in bags for crude clay (dried and crushed), whereas selected air-floated bentonite was quoted at $25 a ton at Chicago. Fuller's earth was quoted at $9 a ton (probably

crude) f. o. b. Colorado and $17 to $21 (ground earth) f. o. b. California. F. o. b. Georgia or Florida mines, quotations were $14.50 per ton for 30- to 60-mesh, $14 per ton for 15- to 30-mesh, $10 for 200-mesh up, and $7 for 100-mesh up. These prices for fuller's earth are almost identical with those for 1935 but are substantially lower than those quoted before the depression, particularly with respect to coarser grindings. Compared with predepression quotations, the figures for china clay likewise are lower but the difference is not so great.

Prices of imported clays were increased somewhat in 1936 because of higher ocean rates. On English clays there was a freight advance on cargo shipments from 14s. to 15s., even higher rates being asked during the weeks when war seemed imminent. On German clays freight rates advanced from $3.75 at the beginning of the year to $4 a ton in December.

The average valuations of several kinds of clay and fuller's earth as reported by producers are shown in the following table.

Average values per short ton of various kinds of clay sold by producers in the United States, 1909–13 and 1925–36

Year	Kaolin		Ball clay	Slip clay	Fire clay and stoneware clay	Bentonite	Fullers' earth
	United States	South Carolina					
1909–13 [1]	$5.34	$3.88	$3.65	$1.81	$1.36	(2)	$9.27
1925–29 [1]	8.45	8.93	7.67	5.41	2.74	(2)	13.95
1930–34 [1]	6.44	6.83	7.16	6.83	2.59	$6.17	10.62
1935	7.19	7.57	6.55	5.99	2.64	5.68	9.79
1936	7.10	7.53	6.87	6.37	2.48	5.37	9.81

[1] Average.
[2] Sales of bentonite not reported separately before 1930.

Prices of common brick, as measured by the composite figure of the United States Bureau of Labor statistics, continued to decline, although only slightly, the average for 1936 being $11.753 per thousand compared with $11.768 in 1935. The low point was in 1933, when the average was $10.53 as compared with around $14 during most of the 10 years prior to 1930.

CONSUMPTION AND USES

The Bureau of Mines began in 1921 to collect data on the distribution of sales of domestic clay according to uses, but these figures do not accurately depict trends of consumption of pottery clays, paper clays, and sundry minor items consumed in industries that are gradually turning away from foreign clays in favor of domestic clays. However, the accompanying table, showing sales of clays by producers, kinds, and uses for 1935 and 1936, affords a fair comparison of actual conditions in the consuming industries during these years, more particularly so because imports are smaller than previously and fluctuate less from year to year.

The feature in the table showing distribution of fuller's earth is the notable increase in the consumption for miscellaneous uses, which include miscellaneous bleaching and filtering as well as use as filler and binder. None is employed nowadays for the original use for fulling cloth.

Clay sold by producers in the United States, 1935–36, by kinds and uses, in short ton

Use	Kaolin	Ball clay	Slip clay	Fire clay	Stoneware clay	Bentonite	Miscellaneous clay	Total
1935								
Pottery and stoneware:								
Whiteware, etc	39,244	65,009		232				104,485
Chemical stoneware	205	623		16,963	4,520			22,311
Stoneware		693		10,713	18,511		300	30,217
Art pottery	368	750		302	1,179		3	2,602
Flowerpots					5,108		473	5,581
Slip for glazing	800	2	894					1,696
	40,617	67,077	894	28,210	29,318		776	166,892
Tile, high-grade	12,612	16,233	292	11,174	275		425	41,011
Kiln furniture, etc.:								
Saggers, pins, stilts	2,228	1,600		40,041				43,869
Wads		1,833		9,261				11,094
	2,228	3,433		49,302				54,963
Architectural terra cotta		1,117		7,585	2,361		1,928	12,991
Paper:								
Filler	273,687	2,000		96			300	276,083
Coating	45,284	671						45,955
	318,971	2,671		96			300	322,038
Rubber	58,846							58,846
Linoleum and oilcloth	6,329	2,946		3,091				12,366
Paints:								
Filler or extender	7,162	354		105			266	7,887
Kalsomine	2,962			709				3,671
	10,124	354		814			266	11,558
Cement manufacture	27,838	184		20,942		288		49,252
Refractories:								
Firebrick and block	28,329	642		1,013,875			964	1,043,810
Bauxite, high-alumina brick		310		2,518				2,828
Fire-clay mortar, including clay processed for laying firebrick	634			235,679			2,938	239,251
Clay crucibles				236			93	329
Glass pots	668			917				1,585
Other glass refractories	274			655				929
Zinc retorts and condensers				9,988				9,988
Foundries and steelworks	2,493	31		286,844		26,354	29,500	345,222
	32,398	983		1,550,712		26,354	33,495	1,643,942
Miscellaneous:								
Rotary drilling mud						65,801	1,501	67,302
Filtering and decolorizing oils (activated earths)						87,822	176	87,998
Artificial abrasives			3,130	134	497			3,761
Asbestos products	678	44		1,371				2,093
Chemicals	1,818			539				2,357
Enameling		239					161	400
Plaster and plaster products	1,827					40	725	2,592
Heavy clay products				147,508	2,000		93,142	242,650
Other uses	9,370	979		81,549	913	10,828	36,819	140,458
	13,693	1,262	3,130	231,101	3,410	164,491	132,524	549,611
Grand total, 1935	523,656	96,260	4,316	1,903,027	35,364	191,133	169,714	2,923,470
1936								
Pottery and stoneware:								
Whiteware, etc	52,196	68,801		1,262				122,259
Chemical stoneware		1,298		22,418	669			24,385
Stoneware				1,511	20,663			22,174
Art pottery	407	444		914	1,576		35	3,376
Flower pots					4,142		2,147	6,289
Slip for glazing		482	671					1,153
	52,603	71,025	671	26,105	27,050		2,182	179,636
Tile, high-grade	13,955	18,109	176	4,453	24		1,133	37,850

Clay sold by producers in the United States, 1935–36, by kinds and uses, in short tons—Continued

Use	Kaolin	Ball clay	Slip clay	Fire clay	Stoneware clay	Bentonite	Miscellaneous clay	Total
1936								
Kiln furniture, etc.:								
Saggers, pins, stilts	2,220	868		38,438				41,526
Wads				10,531			41	10,572
	2,220	868		48,969			41	52,098
Architectural terra cotta		4,735		8,566	4,575		228	18,104
Paper:								
Filler	322,970	2,500		716			378	326,564
Coating	57,056							57,056
	380,026	2,500		716			378	383,620
Rubber	72,712			1,205				73,917
Linoleum and oilcloth	1,620	1,848		8,179				11,647
Paints:								
Filler or extender	10,429	375					384	11,188
Kalsomine	3,233			1,270				4,503
	13,662	375		1,270			384	15,691
Cement manufacture	26,304	578		2,322		520	23,021	52,745
Refractories:								
Firebrick and block	43,556	600		1,399,401				1,443,557
Bauxite, high-alumina brick				7,962				7,962
Fire-clay mortar, including clay processed for laying firebrick	1,674	100		244,194			800	246,768
Clay crucibles				356				356
Glass pots	200			583				783
Other glass refractories	258			6,284				6,542
Zinc retorts and condensers				14,200				14,200
Foundries and steelworks	4,469	30		474,297		47,985	37,577	564,358
	50,157	730		2,147,277		47,985	38,377	2,284,526
Miscellaneous:								
Rotary-drilling mud						140,030	21,348	161,378
Filtering and decolorizing oils (activated earths)						90,704		90,704
Artificial abrasives		44	2,770	1,055	467			4,336
Asbestos products	401			1,254				1,655
Chemicals	3,039							3,039
Enameling	30	100						130
Plaster and plaster products	3,675			958			1,568	6,201
Heavy clay products	2,338			131,226	3,200		169,062	305,826
Other uses	16,197	412		51,544	1,160	12,386	17,626	99,325
	25,680	556	2,770	186,037	4,827	243,120	209,604	672,594
Grand total, 1936	638,939	101,324	3,617	2,435,099	36,476	291,625	275,348	3,782,428

Fuller's earth sold or used by producers in the United States, 1932–36, by uses

Year	Bleaching, clarifying, decolorizing, or filtering—				Other uses		Total	
	Mineral oils		Vegetable oils and animal fats					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1932	208,715	$2,034,955	17,248	$177,016	2,346	$15,756	228,309	$2,227,727
1933	206,100	1,896,501	15,765	169,186	2,287	14,953	224,152	2,080,640
1934	201,902	1,894,140	16,281	176,611	2,081	14,330	220,264	2,085,081
1935	202,525	1,977,056	21,496	223,458	3,724	29,715	227,745	2,230,229
1936	202,809	1,977,825	22,489	238,354	5,516	48,799	230,814	2,264,978

THE INDUSTRY IN FOREIGN COUNTRIES

The world-wide struggle of nations to become self-sufficient with respect to their mineral supplies has altered the international movement of raw clay, and several foreign countries, as well as the United States, have greatly reduced their dependence upon English clays. Other countries have built kilns and factories so as to diminish their imports of pottery, refractories, and other clay products. New discoveries in Belgium have revived kaolin mining at Malvoisin, long abandoned. The Burma China Clay Works, Ltd., a new firm, is reported by vice consul Lyle C. Himmel, Rangoon, to be producing high-duty fire brick and fire clay from pits at Yinnyein, Thaton District, Burma. The interest, growing for some time, in utilizing low-grade kaolin deposits in northeastern Hungary by means of a sedimentation process is confirmed by a report that two new companies were organized in 1936 to produce high-quality china clay and paper clay, respectively. Italian developments include a new undertaking in Agro, county of Cossoine, Sardinia. Portugal, too, now has an established china- and paper-clay mining industry.

The Canadian situation is summed up in the following extract [4] from a report (no. 773) of the Mines Branch, Department of Mines, Ottawa:

> There is a steady demand for various grades of china clay in Canada for use in the manufacture of paper and rubber as well as in the ceramic industry. Ball clays are used in the ceramic industry as a bonding clay in the manufacture of porcelain and similar compounded bodies. While the market in Canada is not large, it is growing and there are also good prospects of developing a profitable export market in the United States. Ball clays of high bond strength occur in extensive deposits in southern Saskatchewan. Deposits of high-grade, white-burning clays occur on Mattagami, Abitibi, and Missinaibi Rivers in northern Ontario. Some of these clays may be classed as ball clays and others as china clays; recent developments at two points in this area will probably result in a small production of clay in the near future. The only place where china clay has been produced commercially in Canada is near St. Remi d'Amherst, Quebec. There are numerous occurrences of clay of bentonitic type in the Prairie Provinces and several deposits are also known in British Columbia. The greater part of the small domestic production has come from deposits at Princeton, British Columbia.

Further recovery was reported by the British clay industry. Exports of china clay from Cornwall amounted to 449,381 long tons in 1936, compared with 430,465 tons in 1935, due to increased sales to the United States and Germany, the leading consumers. English China Clays, Lovering, Pochin & Co. Ltd., the largest producers of china clay in the United Kingdom, installed a new power plant that was said to have cost £110,000 ($550,000) [5] thereby indicating optimism as to the future of the industry as well as a purpose to reduce production costs.

[4] Dept. of Trade & Commerce, The Clay and Clay Products Ind. in Canada 1935: Dominion Bureau of Statistics, Ottawa, 1937, p. 2.

[5] Bureau of Foreign and Domestic Commerce, Foreign Metals and Minerals: Circ. no. 9, Nov. 5, 1936, p. 22.

MAGNESITE AND OTHER MAGNESIUM COMPOUNDS

By Paul M. Tyler and A. E. Davis [1]

SUMMARY OUTLINE

The commercial sources of magnesium are considered in this chapter but not magnesium itself, which now ranks as a fairly important metal. Henceforth, magnesium, instead of being included in the same chapter as its compounds, will be considered in a separate chapter of the Minerals Yearbook.

The interchangeability of magnesium raw materials has become of more than academic interest. Nominally magnesite still heads the list of magnesian minerals, but in 1936 brucite was mined on a commercial scale for the first time. The recovery of magnesium salts from natural brines is increasing. In the United States, magnesium metal is still made exclusively from magnesium chloride of brine-well origin, but it may be feasible later to make it from magnesite or dolomite, as is done abroad. Basic carbonate, formerly obtained exclusively from the treatment of dolomite, is now extracted from the raw sea water of San Francisco Bay.[2] In Germany the method of obtaining magnesium compounds from dolomite by treating the calcined mineral with magnesium chloride (so as to form magnesium hydroxide) has been improved, under an I. G.-controlled process, by directing the reaction between dolomite or limestone and magnesium chloride liquor (probably a potash-works byproduct) so as to recover the magnesia as anhydrous neutral carbonate that settles readily.[3] According to British Patent 442764 the operation is conducted in an autoclave at 150° C. The Pattinson process still accounts for most of the magnesium compounds produced from dolomite, at least in the United States; however, there are numerous other processes, and if any of these prove much cheaper the recovery of magnesium compounds from dolomite may increase. In Japan [4] a new firm has undertaken to make purified magnesium carbonate by calcining Korean and Manchurian magnesites, leaching out the magnesium hydroxide, and reprecipitating the solution with the carbon dioxide from the calcining process.

[1] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.
[2] Chesny, H. Henry, Magnesium Compounds from Ocean Water: Ind. Eng. Chem., vol. 28, April 1936, pp. 383-390.
[3] Chemical Trade Journal (London), Mar. 27, 1936, p. 261.
[4] Chemical Age (London), Magnesium Carbonate, Vol. 34, no. 867, Feb. 8, 1936, p. 130.

Probably no other development so clearly reveals the complete interchangeability of magnesium raw materials as does the decision of the Westvaco Chlorine Products Corporation (which, through a subsidiary organization, has been one of the two large producers of magnesite) that it is more economical under present conditions to produce about 25,000 tons a year of dead-burned refractory magnesite from California salt-works bitterns than to open a new mine in that State. The product of the new chemical plant, construction of which was begun early in 1937, will be comparable in chemical composition and price to the dead-burned product made from natural magnesite.

MAGNESITE

Sales of both foreign and domestic magnesite in the United States increased sharply in 1936 owing to increased steel-making activity and notwithstanding the large purchases made in 1935 for the purpose of again building up stocks to normal. The desire to rebuild stocks was stimulated somewhat further by the tense situation that threatened to cut off supplies from Mediterranean ports, but even so the 37-percent increase in apparent supply of dead-burned magnesite failed to equal the 40-percent increase in domestic steel production over 1935. There was a small increase in the use of caustic calcined magnesite, although the 7,998 tons reported in 1936 represents only a fraction of the 42,654 tons supplied in 1924, when the use of magnesium oxychloride cements for stucco and flooring reached its maximum in the United States. Possible revival of their use, however, is forecast as a result of laboratory investigations at the Mellon Institute of Industrial Research. By the addition of 10 percent of finely divided copper powder, many of the shortcomings of magnesium oxychloride cements appear to be eliminated and their useful field correspondingly widened. During the time the cement is hardening and for long periods afterward, the metal is converted to a new cementing material that resembles the natural mineral, atacamite ($CuCl_2.3Cu(OH)_2$).[5] Apparently several times as much caustic calcined magnesite is now used in the United States as a chemical accelerator in rubber as is used in oxychloride cements. Although the quantity of these cements used in stucco has decreased, the quantity employed in flooring and wallboard has increased. Caustic calcined magnesite is also used as a base for magnesium salts and for heat-insulating materials.

[5] Hubbell, Dean S., A New Inorganic Cement and Adhesive: Ind. and Eng. Chem., vol. 29, no. 2, 1937, pp. 123-132.

Salient statistics of the magnesite industry in the United States, 1925–29 (average) and 1933–36

	1925–29 (average)	1933	1934	1935	1936
Crude:					
Mined:					
Short tons	138, 102	108, 187	100, 973	177, 154	207, 119
Value [1]	$1, 264, 526	$840, 000	$730, 630	$1, 192, 052	$1, 411, 664
Sold by producers:					
Short tons	1, 210	1, 576	1, 588	1, 626	1, 669
Value	$13, 310	$20, 769	$18, 393	$22, 345	$24, 420
Average per ton [2]	$11. 00	$13. 18	$11. 58	$13. 74	$14. 63
Imports for consumption:					
Short tons	603	11	50	49	59
Value	$6, 191	$200	$706	$1, 084	$1, 130
Apparent new supply ..... short tons	1, 813	1, 587	1, 638	1, 675	1, 728
Percent domestic	66. 7	99. 3	96. 9	97. 1	96. 6
Caustic calcined:					
Sold by producers:					
Short tons	16, 214	[3] 4, 835	[3] 4, 110	[3] 6, 049	7, 998
Value	$538, 344	[3] $143, 250	[3] $120, 525	[3] $170, 326	$221, 410
Average per ton [2]	$33. 20	[3] $29. 63	[3] $29. 32	[3] $28. 16	$27. 68
Imports for consumption:					
Short tons	10, 675	1, 850	1, 553	1, 441	2, 196
Value	$249, 182	$33, 081	$36, 031	$36, 076	$49, 674
Apparent new supply ..... short tons	26, 889	[3] 6, 685	[3] 5, 663	[3] 7, 490	10, 194
Percent domestic	60. 3	72. 3	[3] 72. 6	[3] 80. 8	78. 5
Dead-burned:					
Sold by producers:					
Short tons	47, 158	[3] 46, 919	[3] 41, 953	[3] 72, 438	89, 979
Value	$1, 124, 618	[3] $880, 740	[3] $772, 233	[3] $1, 361, 949	$1, 713, 527
Average per ton [2]	$23. 85	$18. 77	[3] $18. 41	[3] $18. 80	$19. 04
Imports for consumption:					
Short tons	56, 787	23, 509	22, 921	24, 674	42, 608
Value	$828, 663	$341, 780	$368, 014	$429, 830	$662, 567
Apparent new supply ..... short tons	103, 945	[3] 70, 428	[3] 64, 874	[3] 97, 112	132, 587
Percent domestic	45. 4	66. 6	[3] 64. 7	[3] 74. 6	67. 9

[1] Partly estimated; most of the crude is processed by the mining companies, and very little enters open market.
[2] Average receipts f. o. b. mine shipping point.
[3] Revised figures.

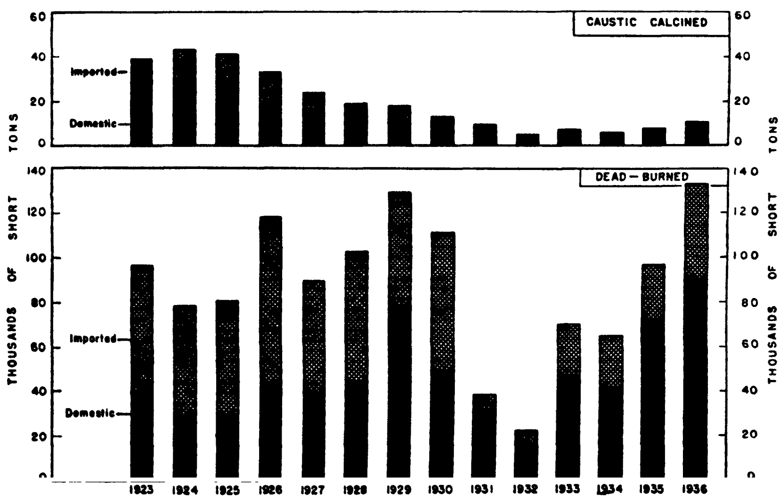


FIGURE 99.—Apparent new supply of caustic calcined and dead-burned magnesite in the United States from domestic and foreign sources, 1923–36.

DOMESTIC PRODUCTION

Following a 75-percent increase in the production of crude magnesite from California and Washington in 1935 over the previous year, the output in 1936 rose to 207,119 short tons, a 17-percent increase over

1935 and the largest reported since 1920, when 303,767 tons of crude magnesite were mined in the United States. Of the 1936 output, only 1,669 tons, valued at $24,420, were sold as crude. The total value of the mine output in 1936 is estimated at $1,411,664, but this value is purely nominal, as the mining companies convert most of the material into dead-burned or caustic calcined magnesite.

Only two companies mined domestic magnesite in 1936; but recovery of byproduct magnesite is anticipated in Vermont, and production of brucite in Nevada has already begun on a commercial scale.

California.—The California Chemical Co. (220 Bush St., San Francisco, Calif.), formerly a subsidiary of United Chemicals Co., operated the Robert Hays Smith mining property about 28 miles north of Patterson throughout 1936. This mine, which was purchased in 1935, has been worked out and now is permanently closed; all usable equipment was moved away during the first quarter of 1937. The crude ore from the property was converted almost entirely into dead-burned magnesite and periclase grain in the rotary kiln at Patterson which was leased and rehabilitated for that purpose. Company operations at both its Bald Eagle and Western mines were continuing at full capacity after the close of 1936, but these properties were unable to supply the increased demand. Production of dead-burned magnesite by the company henceforth will be augmented by the synthetic product to be made from salt-works bittern in its new chemical plant. The output of the Bald Eagle mine in Stanislaus County is shipped from Ingomar and that of the Western mine (Santa Clara County) from Livermore. Each of these mines is equipped with oil-fired rotary kilns producing both dead-burned and caustic material. The Western mine, formerly known as the Red Mountain, is leased from the Western Magnesite Development Co. and operated through tunnels. Early in 1936, 40 men were reported as being employed at this property, of whom 10 were in the 20-ton mill; 117 men were working at the Bald Eagle mine, of whom 12 were in the 50-ton mill at that property. On January 30, 1937, complete control of the California Chemical Co. was acquired by Westvaco Chlorine Products Corporation.

Nevada.—During the depression, the Standard Slag Co., of Youngstown, Ohio, relinquished its lease on the Springer claims near Luning, Nev., and the U. S. Brucite Corporation was dissolved. The property is now owned by the U. S. Brucite Co., of which Dr. Thomas R. Haig, of Sacramento, Calif., is president. In October 1936 operations were begun under lease by Basic Dolomite, Inc. (845 Hanna Bldg., Cleveland, Ohio), which made substantial shipments to its eastern plant before the end of the year when operations were suspended temporarily owing to an unprecedented snowfall. It is expected that several thousand tons of brucite will be required annually as a base for the material to be sold under the trade name "Thomasite" covered by United States Patent 1965605.

Vermont.—The Eastern Magnesia Talc Co. (Burlington, Vt.) continued its flotation tests made in cooperation with the Bureau of Mines and in 1936 was building a plant which began operating in February 1937. Besides increasing recoveries and improving the quality of the talc, the new plant is expected to produce a tailing of magnesite low in lime and silica but fairly high in iron. Details of marketing this product had not been worked out by the end of 1936.

Washington.—The Northwest Magnesite Co. (executive offices, Farmers Bank Building, Pittsburgh, Pa.) continued to operate its Finch mine and produced considerable magnesite from the nearby Allen-Moss quarries, from which shipments were first made in 1917 by the American Mineral Production Co. All holdings of the latter concern were acquired in 1923 by the Northwest Magnesite Co., which is the only operator in the State. The calcining equipment at Chewelah, comprising six rotary kilns capable of handling a total of 300 tons daily, was operated at more than 50-percent capacity during 1936. In addition to dead-burned magnesite a moderate quantity of caustic-calcined magnesite is made for use in the manufacture of the insulating and fireproofing product which the company markets under the trade name "Thermax."

IMPORTS

Notwithstanding the substantial increase in domestic production, imports of dead-burned magnesite increased notably in 1936 and those of caustic calcined material increased a little. Imports credited to Austria, which as usual was the principal source of dead-burned magnesite, increased proportionately more than total imports. The so-called magnesitic dolomite produced in Argenteuil County, Quebec, and formerly imported as "magnesite", is now classified for customs purposes under paragraph 214 of the Tariff Act of 1930 and more specifically provided for under the Reciprocal Trade Agreement with Canada, effective January 1, 1936, as "dead-burned basic refractory material containing 6 percent or more of lime and consisting chiefly of magnesia and lime." Statistics of imports of this material are given later in this chapter under "Dolomite."

Magnesite imported for consumption into the United States, 1935–36, by countries and classes

Country	Crude		Caustic calcined				Dead-burned, and grain and periclase	
			Lump		Ground			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935								
Austria							12,765	$216,937
Canada							103	8,422
Czechoslovakia					55	$1,417	3,516	65,129
Germany					5	672		
Greece			55	$1,417	49	1,194		
India, British			381	6,207				
Italy							4,083	69,884
Netherlands	49	$1,084	92	1,956	549	15,650		
U. S. S. R. (Russia)							4,207	69,458
United Kingdom			10	276	86	3,160		
Yugoslavia			15	390	144	3,737		
	49	1,084	553	10,246	888	25,830	24,674	429,830
1936								
Austria							22,496	331,890
Canada							394	36,490
Czechoslovakia							13,628	201,424
Germany					4	214		
Greece			224	5,817	35	987		
India, British	11	18	896	13,280				
Japan							112	1,628
Kwantung							1,288	14,592
Netherlands	48	1,112	124	3,304	645	18,049		
Norway							35	2,513
U. S. S. R. (Russia)							4,655	74,030
United Kingdom			1	152	79	2,796		
Yugoslavia					188	5,075		
	59	1,130	1,245	22,553	951	27,121	42,608	662,567

PRICES

The quotations reported for magnesite in 1935 were unchanged in 1936. Dead-burned magnesite remained at $22 per short ton f. o. b. Chewelah, Wash., and $25 per ton f. o. b. California mines, equivalent to about $35 a ton delivered at Pittsburgh, Pa. High-grade periclase (94-percent grade) continued to be quoted at $65 and the 90-percent (actually about 92-percent) grade at $35 a ton f. o. b. California shipping point. The top price for caustic calcined magnesite was still $40 per ton for the 95-percent grade.

Import valuations tended to be somewhat lower in 1936 than in 1935, but much of the variation can probably be explained by differences in the basing point, as import valuations are calculated f. o. b. foreign shipping point. A shipment of Austrian magnesite, for example, would be worth nominally more if invoiced from the Italian port of Trieste than from the mines.

THE INDUSTRY IN FOREIGN COUNTRIES

World production of magnesite, 1931–35, by countries, in metric tons [1]

[Compiled by M. T. Latus]

Country	1931	1932	1933	1934	1935
Anglo-Egyptian Sudan					256
Australia:					
New South Wales	3,480	5,199	9,512	15,902	15,940
Queensland		132	152	42	
South Australia		117	205	208	51
Victoria	51	29	6	26	234
Austria	179,440	134,409	164,331	258,382	300,312
Canada [2]	24,345	2,833	27,158	27,385	27,129
China (Manchuria)	36,034	55,386	71,376	72,000	(3)
Chosen	(3)	(3)	(3)	3,168	2,410
Czechoslovakia [4]	38,918	33,965	49,935	58,235	70,838
Germany	(3)	(3)	(3)	11,010	13,818
Greece	49,990	44,699	44,719	70,388	(3)
India, British	5,419	14,087	15,450	15,215	17,257
Italy	3,470	460	2,187	1,100	950
Norway	1,580	1,311	2,007	2,500	2,526
Southern Rhodesia		14			
Turkey	2,197	310	951	628	1,092
Union of South Africa	1,357	1,418	1,495	1,667	1,485
U. S. S. R. (Russia)	[5] 246,000	334,454	380,300	482,000	(3)
United States	66,770	34,892	98,145	91,601	160,711
Yugoslavia [6]	32,209	33,317	14,602	25,086	30,225

[1] Unless otherwise stated quantities in this table represent crude magnesite mined.
[2] Magnesitic dolomite.
[3] Data not available.
[4] Exports, less imports, of crude and sintered magnesite, the sintered being reduced to crude on the basis of 2.1 tons crude to 1 ton sintered.
[5] Year ended Sept. 30.
[6] Serbia only.

Austria.—Due to increased shipments to the United States, exports of dead-burned magnesite from Austria rose to 63,944 metric tons, compared with 55,121 tons in 1935. Great Britain, second largest buyer of Austrian dead-burned magnesite, increased its purchases very slightly, while sales to other countries, especially to Germany, generally declined. Exports of caustic calcined magnesite, most of which go to Germany, increased to 43,968 metric tons as against 34,317 tons during 1935, the small exports of crude magnesite advanced moderately to 9,203 metric tons in 1936 from 7,169 tons in 1935. Less magnesite bricks and plates were exported to Germany and Italy, but larger sales to Great Britain and France resulted in an increase for these items also; the total exports in this category were 39,263 metric tons in 1936 compared with 35,960 tons during 1935.

Crude magnesite was exported in 1936 only to Germany where it is used at Bitterfeld for the manufacture of magnesium. This magnesite is low in iron (1½ percent) and comes from the Zillerthal mine of the Alpenländische Bergbau Gesellschaft (owned by Friedrich Krupp Gesellschaft, Essen, Germany).

The Wald magnesite mine belongs to the Alpine Montan Gesellschaft, Vienna, and is worked only to provide refractories for steel plants owned by that company.

The bulk of the Austrian output is furnished by three companies. The largest is the Veitscher-Magnesitwerke A. G. (capital 7,500,000 schillings) which operates three mines and employed an average of 950 men in 1936. This company produces only dead-burned magnesite, about 40 percent of which it manufactures into brick or other shapes. It exports 90 percent of its product. The Oesterreichisch-Amerikanische Magnesit A. G. (capital 14,000,000 schillings) employs about 750 men and produces chiefly dead-burned magnesite and magnesite brick for export and caustic calcined magnesite and dust for making floor tile and insulating board (Heraklith). The Steirisch Magnesit Industrie A. G. (capital 2,000,000 schillings), the third largest producer, is not a member of the European cartel and sells only caustic calcined magnesite, 90 percent of which is exported to Germany.

Export prices of Austrian magnesite declined in 1936. The price of dead-burned magnesite during the first 9 months of 1936 was 159.79 schillings a metric ton compared with 167.83 schillings during 1935. The export price of bricks and plates declined about 4 percent from the 1935 average to 387.22 schillings per metric ton, and that for caustic calcined magnesite also dropped about 4 percent to 98.95 schillings. The average exchange rate for the Austrian schilling was $0.1879 in United States currency in 1936 and $0.1883 in 1935.

Canada.—"Magnesitic dolomite" is produced in Argenteuil County, Quebec, about 60 miles west of Montreal and north of the Ottawa River, by the International Magnesite Co., Ltd., and Canadian Refractories, Ltd. The latter company reduces the crude rock to about 100 mesh and then dead-burns it in rotary kilns. The value of production and statistics of imports of this material into the United States are given later in this chapter, under "Dolomite."

Chosen (Korea).[6]—Two companies are producing magnesite in northern Chosen, near Gosui, North Kankyo Province; the calcined product, including some magnesite brick, is shipped to Japan.

Greece.—After exports of magnesite had declined sharply in the first quarter they resumed their upward trend, and shipments increased substantially in 1936 over those in 1935. As usual the Netherlands was the largest buyer, especially of the crude product. Shipments of crude totaled 45,290 metric tons; of caustic calcined 23,716 tons; and of dead-burned magnesite 11,985 tons. Corresponding figures for 1935 were 33,502 tons, 22,502 tons, and 9,191 tons, respectively. No shipments to the United States were reported either in 1935 or 1936.

India, British.—Magnesite from Madras is principally high grade, and suitable for making sorel cement and plastic products; for use by the local steel industry it is mixed with 2 percent iron ore and burned into brick at 1,600° C.

Italy.—According to a report [7] from American Vice Consul William

[6] Langdon, Wm. R. (U. S. Consul, Seoul), Mineral Trade Notes; Bureau of Mines, vol. 2, no. 6, June 1936, pp. 21–22.

[7] U. S. Bureau of Mines, Mineral Trade Notes: Vol. 3, no. 2, August 1936, pp. 15–16.

P. Shockley, Jr. (Leghorn), magnesite occurs abundantly in the hills about 2 km east of the Tyrrhenian Sea and about 3 km north of the town of Castiglioncello, Commune Rossignana Marittime, Leghorn Province. Deposits in this region were worked actively during the World War, and although much of the magnesite produced therefrom has been unmarketable it is believed that commercial operations might be resumed successfully under adequate technical supervision. In analysis the Castiglioncello magnesite is more like the Austrian than the Greek product. Evidently it has to be sorted rather carefully but the following analysis is given as representative of "material that can be utilized": Magnesia, 42.45 percent; lime, 3.15 percent; iron oxides, 1.80 percent; insoluble ("stone"), 3.40 percent; and loss on ignition, 49.20 percent. This analysis corresponds to a magnesium carbonate content of 89 percent.

Imports of magnesite into the United States are occasionally reported in the official statistics as coming from Italy, but it is believed that they consist exclusively of Austrian magnesite that happened to be invoiced at Trieste, which became an Italian port after the World War.

Manchuria.[8]—Production of magnesite in Manchuria first rose above 10,000 tons in 1924 and did not rise above 35,000 tons until 1931, but since then it has increased rapidly to 134,220 tons in 1935. Originally most of the Manchurian magnesite was consumed in Japan, but in recent years exports have been made to Europe. About 2,000 tons of magnesite products per year, mostly clinker, have been used for making brick at the iron works of Anshan and Pen-hsi-hu, near Mukden. In addition, about 3,000 tons of caustic magnesite were used in 1935 for making sorel cement. Seven factories for treating Manchurian magnesite have been built since 1918; all are between Mukden and Dairen. The oldest and by far the largest is that of the South Manchurian Mining Co. (Nan-man-Kögyo-Kaisha), which produces about 2,500 tons of clinker and 250 tons of caustic magnesite per month—more than twice as much as all the other plants combined.

Several sizes of dead-burned magnesite are produced. That in lumps, 1 to 3 cm in diameter sells for about 50 yen per ton at the port of Ying-Kou, 22 km west of Ta-shih-chiao. Caustic magnesite, mostly powdered, is cheaper (about 41 yen per ton at the same port). Probably 90 percent of the Manchurian magnesite is used for refractory purposes, after being dead burned in Manchuria, Japan, or elsewhere.

Prior to 1936 none of the Manchurian magnesite had been used for making metallic magnesium. However, in 1935 substantial tonnage of metal was made in Korea from Korean magnesite, and preparations have been made for utilizing Manchurian magnesite for this purpose at the plant in the city of Ubé, Yamaguchi Prefecture, western Japan, where several hundred tons of magnesium metal have been made from bitterns obtained from nearby salt works.

The Manchurian magnesite deposits are among the largest in the world. One group on the east side of Ta-shih-chiao occupies an area 50 km long (from east to west) and 6 km wide and contains 5,000 million tons. The magnesite is associated with pre-Cambrian dolomites and schists that generally strike east to west and dip to the south. These deposits, controlled by the South Manchurian Railway

[8] Niinomy, K., Recent Developments in Magnesite Industry of Manchoukuo: Econ. Geol., vol. 31, no. 7, November 1936, pp. 767–769; Magnesite Deposits of Manchuria; Econ. Geol., vol. 20, 1925, pp. 25–53.

Co., are now managed by the Manchu Mining Development Co. (Manshu-Kozan-Kaihatsu-Kaisha).

Norway.—A Bergen firm is reported [9] to have obtained a lease for working on a royalty basis magnesite deposits recently discovered at Hegvestad.

South Africa.—High-grade magnesite, mined in the Barberton and Lydenburg districts, is used locally for flooring cements; the carbon dioxide is recovered and sold in cylinders as compressed gas. An average analysis shows: $MgCO_3$, 97.37 percent; $CaCO_3$, 0.85 percent; SiO_2, 1.20 percent; and Fe_2O_3, 0.48 percent. Research has been in progress for a year or two with a view to making magnesite brick from this material.

Turkey.[10]—Large deposits of high-grade magnesite are reported in the Denizli and Eskishehir districts; in the latter area the magnesite runs up to 97.4 percent $MgCO_3$ and is quite low in iron. Following a reduction in railway transportation costs a private enterprise began mining in the Eskishehir district and expected to make exports in 1936. German buyers were negotiating for the product at 9 to 9½ Turkish pounds a ton, which was considered rather a high price. It was believed that by utilizing idle cement kilns in Istanbul caustic calcined magnesite could be offered locally at 70 to 80 shillings.

Yugoslavia.—High-grade magnesite, 96 to 99 percent pure, is reported to have been discovered in the Takovo district of the Danube Banovina, according to a brief statement from Consul Charles S. Reed, second, Belgrade. Consul Reed Paige Clark reports that Yugoslavia has five important magnesite deposits and eight mines. Nine-tenths of the total supply lies in the Valjevo-Cacak-Pozega-Nova Varos-Priboj-Visegrad-Bajina Basta territory. The largest section of country south of Valjevo is served by a narrow-gage railway. Magnesite is exported crude, ground or unground, and sintered. A representative sample of crude ore carries 98 percent $MgCO_3$ and one calcined ore, 90 to 95 percent MgO. The ore contains little silica and alumina. Exports in 1934 were 1,333 short tons of lump magnesite and 9,324 tons of ground and calcined magnesite. During the first half of 1935 exporting rates were much higher.

DOLOMITE

Dolomite (magnesium-calcium carbonate) is a source of most of the basic carbonate used in "85-percent magnesia" pipe and boiler coverings and competes with magnesite and natural brines as a source of magnesium salts for medicinal and technical use. Dead-burned dolomite is many times as important as dead-burned magnesite as a steel-works refractory (at least as regards tonnage consumed), and dolomitic lime is used in making sulphite pulp and for sundry other purposes that formerly consumed substantial tonnages of magnesite. Raw dolomite is used for patching open-hearth furnace bottoms and for making carbon dioxide, often with Epsom salts as a joint product.

In 1936 sales of dead-burned dolomite rose to 557,000 tons valued at $4,693,000 (preliminary figures) compared with 455, 258 short tons valued at $3,785,834 in 1935, an increase of 22 percent in quantity and 24 percent in value. In 1935, 4,965 tons of lime were sold to magnesia works and paper mills used 344,531 tons of lime, most of

[9] Chemistry and Industry (London), Industrial Notes from Abroad: Vol. 56, no. 3, Jan. 16, 1937, p. 63.
[10] Data from Acting Commercial Attaché John A. Embry, Istanbul, Foreign Met. and Min. Circ. 4, May 15, 1936, p. 27; no. 5, June 15, 1936, pp. 27–28.

which was dolomitic. Detailed figures as to use of lime and data as to the distribution of raw stone are given in the Lime and Stone chapters. For many uses dolomitic limes or high-magnesium limestones are more effective than high-calcium lime or stone, but it is impossible to draw even an approximately accurate distinction between the uses in which the magnesia content plays a dominant or important role. It seems likely that in many instances a magnesian limestone may be rejected in favor of a high-calcium lime stone from another source, or vice versa, for some reason other than the lime-magnesia ratio. More intelligent analysis might show that the underlying cause of such rejection is poor grading of the stone from a local quarry or some constituent impurity. Accordingly there is no statistical approach to the problem of when a magnesia content represents an advantage and when a disadvantage.

Imports of dead-burned dolomite have been reported separately since 1930; these comprise principally the so-called magnesitic dolomite dead burned in Canada for steel-works refractories. In 1936, after the reciprocal treaty had been concluded between the two countries, the classification was modified to read "dead-burned basic refractory material containing 6 percent or more of lime and consisting chiefly of magnesia and lime", and imports rose to 13,928 short tons valued at $349,678 compared with 7,519 tons valued at $189,714 in 1935. Statistics are available only on the value of this material in Quebec. According to the preliminary report of the Dominion Bureau of Statistics, the Canadian output of magnesitic dolomite was valued at $769,176 in 1936, a 58-percent increase over the $486,084 in 1935.

MAGNESIUM SALTS

Improved technique for handling magnesium precipitates, especially from dilute solutions, has made possible the commercial recovery not only of technical carbonate but of refractories and other moderately low priced magnesia products from natural brines and bitterns and even from raw ocean water. As a result, the potential importance of natural magnesium salts has increased enormously.

DOMESTIC PRODUCTION

The total quantity of natural magnesium salts (sulphate, chloride, and carbonate from brine wells and sea water) sold or used in the United States, as reported by producers, increased in 1936 to 127,682,793 pounds valued at $1,629,725 compared with 109,601,855 pounds valued at $1,286,804 in 1935. Magnesium sulphate still leads the magnesium salts in quantity produced, but separate figures for this salt and for the chloride and carbonate may not be published.

The Dow Chemical Co., Midland, Mich, produced both magnesium sulphate and chloride from its natural brines. The California Chemical Co., operating at San Francisco, recovered magnesium chloride from bittern waters. Magnesium carbonate was produced from sea water by the Marine Chemicals Co., Ltd., South San Francisco, Calif., and the Plant Rubber & Asbestos Works (537 Brannan Street, San Francisco, Calif.); also from the salt wells of the Morton Salt Co. (208 West Washington Street, Chicago, Ill.), in Manistee County, Mich. C. A. Kearney (1208 Post Street, Seattle, Wash.), reported production of magnesium sulphate from natural deposits of epsomite near Oroville, Okanogan County, Wash.

IMPORTS

German shipments of magnesium chloride to the United States have dwindled to insignificant proportions, and notwithstanding a notable recovery in 1936 shipments of magnesium sulphate likewise have diminished greatly during the last 15 years. On the other hand, imports of calcined magnesia and precipitated carbonate, mostly of British origin, have increased, as shown in the following table.

Magnesium compounds imported for consumption in the United States, 1920–36 [1]

Year	Magnesium chloride (hydrated and anhydrous)		Magnesium sulphate (Epsom salts)		Calcined magnesia		Carbonate, precipitated		Magnesium silicofluoride or fluosilicate	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1920–24 (average)	11,495,360	$96,479	12,610,276	$96,889	80,441	$18,542	319,625	$16,486	(2)	(2)
1925–29 (average)	9,858,618	68,144	10,886,654	63,205	342,997	57,419	316,153	19,335	(2)	(2)
1930–34 (average)	861,138	8,267	8,357,367	51,761	389,467	69,426	581,958	26,662	47,221	$2,654
1935 [1]	50,094	1,095	3,060,883	18,495	196,264	36,297	601,459	27,935	98,037	6,500
1936 [1]	31,876	584	4,334,792	25,008	238,039	39,098	754,084	34,396	(3)	(3)

[1] In addition to the items reported separately 3,668,091 pounds of calcined magnesium sulphate or calcined Kieserite (not fertilizer) valued at $30,291 were imported in 1935, and 5,439,651 pounds valued at $44,664 in 1936. Also 11,200 pounds of "manufactures of carbonate of magnesia" valued at $489 were imported in 1935, none were recorded in 1936.

[2] Data not available.

[3] Not reported separately. Included in magnesium salts and compounds, n. s. p. f., which shows importation of 372,291 pounds, valued at $29,355.

ABRASIVE MATERIALS

By Bertrand L. Johnson and A. E. Davis

SUMMARY OUTLINE

Further increases marked production of most of the important abrasive materials in 1936. Compared with 1935 there were substantial increases in the output of ground sand and sandstone, pumice and pumicite, oilstones and related products, garnet, and emery. Moderate gains were also reported in the production of tripoli and millstones. These gains, however, were offset by decreases in the production of quartz and grindstones and pulpstones. The aggregate value of the abrasive materials produced in 1936, exclusive of diatomite for which the Bureau of Mines is not at liberty to publish annual figures, was $11,186,941 compared with $11,196,424 in 1935.

Abrasive materials are used extensively in the manufacture of numerous products. The quantities used are related directly to the production of various commodities; hence the volume of production is to a considerable extent an indicator of industrial activity. The following table of salient statistics therefore presents not only trends in activity of each abrasive material but also to some degree those of the industries in which the abrasives are employed.

Some commodities included in this chapter also have important nonabrasive uses. For example, the quantity of diatomite now used as an abrasive is relatively small compared with the quantity formerly so used. It seems desirable, however, to continue to include such commodities in the annual chapters of this series for purposes of comparison until the minerals in this diverse group are reclassified. On the other hand, it should be noted that figures covering the quantities of sundry materials used for abrasives and mentioned later under the caption "Miscellaneous abrasive materials" are not included in this chapter.

Salient statistics of abrasives industries in the United States, 1935-36

	1935	1936	Percent of change in 1936
Domestic production (sold or used by producers):			
Natural silica abrasives:			
Diatomite	[1] $1,206,143	(2)	
Tripoli (value as sold—crude and finished)	383,416	$391,878	+2.2
Quartz	111,784	96,592	−13.6
Ground sand and sandstone	[3] 1,678,295	2,146,464	+27.9
Special silica stone products:			
Grindstones and pulpstones	505,378	497,997	−1.5
Oilstones and related products	105,589	121,196	+14.8
Millstones	9,530	10,609	+11.3
Natural silicate abrasives:			
Pumice and pumicite	[3] 247,076	328,406	+32.9
Garnet	256,520	315,913	+23.2
Natural alumina abrasives:			
Emery	1,606	2,900	+80.6
Total natural abrasives	[3] 4,505,337	[4] 3,911,955	
Total artificial abrasives	6,691,087	7,274,986	+8.7
Grand total (natural and artificial)	[3] 11,196,424	[4] 11,186,941	
Foreign trade:			
Imports	5,125,379	5,160,524	+.7
Exports	515,547	542,548	+5.2

[1] Average for 1933-35; Bureau of Mines not at liberty to publish annual figures.
[2] Bureau of Mines not at liberty to publish annual figures.
[3] Revised figures.
[4] Exclusive of value of diatomite.

NATURAL SILICA ABRASIVES

Diatomite.—Diatomite is still used as a mild abrasive in metal polishes, scouring and cleansing soaps and compounds, dentifrices and nail polishes, although its principal outlets, in the insulation, filtering, and absorption-agent fields, are nonabrasive.

The principal centers of diatomite production in the United States are now the Western States; four of the seven States that produced diatomite in 1936—California, Oregon, Washington, and Nevada—were in that region, and the remaining three—New York, New Jersey, and Florida—were in the East. There were 18 producing companies in the United States in 1936; all but 3 of them were in the western area.

California, with its immense deposits, was the chief source of the diatomite produced in the United States in 1936, as it has been in recent years; eight companies operated on deposits in central and southwestern California—three at Lompoc, Santa Barbara County; two at Walteria and one at Palos Verdes, Los Angeles County; and one each at Mendota, Fresno County, and Bradley, Monterey County.

In Nevada three producers were operating at widely scattered localities—one near Virginia City, Storey County, in the west-central part of the State; another near Tonopah, Esmeralda County, in the southwestern part of Nevada; and the third near Carlin, Elko County, in the northeastern corner of the State.

The three producing companies in Washington are reported to have operated deposits in 1936 in Kittitas, Grant, and Adams Counties.

Only one company was operating in each of the other States—Oregon, New York, New Jersey, and Florida.

Diatomite sold or used by producers in the United States, 1930–35 [1]

Year	Short tons	Value	Year	Short tons	Value
1930 1931 1932	248,273	$3,902,126	1933 1934 1935	244,342	$3,618,428

[1] Bureau of Mines not at liberty to publish annual figures.

The trend of diatomite production in immediate predepression years was upward. (See figure 100.) Since 1929, the trend, as indicated by 3-year averages, appears to have been downward, but annual production figures, which the Bureau of Mines is not at liberty to publish, show a marked recovery in the production of diatomite from the depression low in 1932.

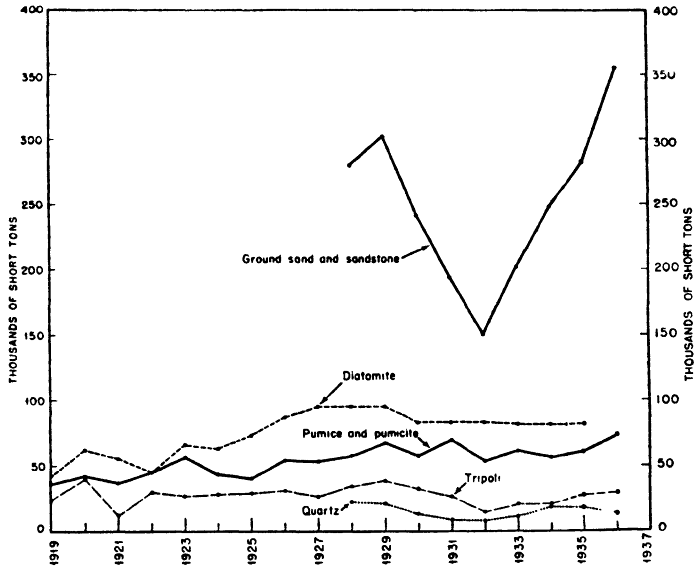


FIGURE 100.—Trends in production of diatomite, tripoli, pumice and pumicite, quartz, and ground sand and sandstone, 1919–36.

The companies reporting production and sales of diatomite in the United States in 1936, with locations of the deposits from which it was obtained, were as follows:

Adirondack Diatomaceous Earth Co., Keene, N. H. Deposit near Poland, Herkimer County, N. Y.

American Diatomite Corporation. Deposit and office at Clermont, Lake County, Fla.

Diatomaceous Earth Corporation of America, 1325 Pico Avenue, Long Beach, Calif. Deposit at Walteria, Los Angeles County, Calif.

The Dicalite Co., 756 South Broadway, Los Angeles, Calif. Deposit at Walteria, Los Angeles County, Calif.

The Electro-Silicon Co., 130 Cedar Street, New York, N. Y. Deposit at Virginia City, Storey County, Nev.

Johns-Manville Products Corporation, 22 East Fortieth Street, New York, N. Y. Deposit at Lompoc, Santa Barbara County, Calif.

Kittitas Diatomite Co., Washington National Bank Building, Ellensburg, Wash. Deposit at Kittitas, Kittitas County, Wash.

Langlois Bros., 717 South San Pedro Street, Los Angeles, Calif. Deposit near Tonopah in Esmeralda County, Nev.

Marcrum, J. G., Netcong, N. J. Deposit near Stanhope, Sussex County, N. J.

Mineral Products Manufacturing Co., 1735 Ventura Avenue, Fresno, Calif. Deposit at Mendota, Fresno County, Calif.

National Silica Products Co., 1201 Bryant Street, Palo Alto, Calif. Deposit at Lompoc, Santa Barbara County, Calif.

The Oromite Co., American Bank Building, Portland Oreg. Deposit at Terrebonne, Deschutes County, Oreg. (Successor to the Atomite Products Co.)

Pacatome, Ltd., Bradley, Calif. Deposit near Bradley, Monterey County, Calif.

The Paraffine Cos., Inc., 475 Brannan Street, San Francisco, Calif. Deposit near Lompoc, Santa Barbara County, Calif.

Raylite Aggregates, Inc., 1302 Park Central Building, Los Angeles, Calif. Deposit at Palos Verdes, Los Angeles County, Calif.

State Products Co., 315 South Fourth Avenue, Yakima, Wash. Deposits at Quincy, Grant County; Othello, Adams County; and in Kittitas County, Wash.

Tri-O-Lite Products Co. Deposit and office at Carlin, Elko County, Nev.

Webley, E. J. Deposit and office at Quincy, Grant County, Wash.

Although diatomite occurs in nearly every country in the world it has been produced in only 23 countries in recent years. The United States is by far the largest producer, but considerable quantities are produced in Algeria, Australia, Denmark, France, Germany, Hungary, Italy, Japan, Northern Ireland, Portugal, and Sweden. No 1936 production figures are yet available. The largest foreign producing countries in 1935 were Denmark with 47,200 long tons of an impure diatomaceous earth called "molererde" and Algeria with 11,200 tons of diatomite.

Tripoli.—The materials grouped under this heading include certain naturally occurring and extremely fine-grained forms of silica, such as tripoli and rottenstone. Deposits of tripoli occur in southeastern,[1] central, and western United States, but the tripoli industry has centered largely in the Missouri-Oklahoma and Illinois fields. Rottenstone is produced only in Pennsylvania.

The tripoli industry of the United States is small; the tonnage produced annually in the post-war years has ranged from 12,000 to 40,000 short tons. In 1936, 28,487 short tons of tripoli and related products were produced in Arkansas, California, Illinois, Missouri, Oklahoma, and Pennsylvania. The Missouri-Oklahoma and Illinois fields were

Tripoli (including Pennsylvania rottenstone) sold or used by producers in the United States, 1932–36

Year	Illinois			Other States [1]			Total		
	Short tons	Value		Short tons	Value		Short tons	Value	
		Crude (partly estimated)	As sold (crude and finished)		Crude (partly estimated)	As sold (crude and finished)		Crude (partly estimated)	As sold (crude and finished)
1932	6,097	$10,895	$84,795	8,678	$20,527	$147,905	14,775	$31,422	$232,700
1933	8,757	18,103	149,979	12,121	27,582	200,404	20,878	45,685	350,383
1934 [2]	7,417	17,241	119,418	13,112	27,622	209,938	20,529	44,863	329,356
1935	10,001	19,149	113,484	17,374	42,640	269,932	27.375	61,789	383,416
1936	10,981	21,962	138,063	17,506	61,546	253,815	28,487	83,508	391,878

[1] 1932: Arkansas, Missouri, Oklahoma, Pennsylvania, and Tennessee; 1933–34: Arkansas, California, Georgia, Missouri, Oklahoma, Pennsylvania, and Tennessee; 1935: Arkansas, California, Georgia, Missouri, Oklahoma, and Pennsylvania; 1936: Arkansas, California, Missouri, Oklahoma, and Pennsylvania.
[2] No sales of crude reported in 1934.

[1] Crickmay, C. W., Tripoli Deposits of Georgia: Georgia Dept. Forestry and Geol. Devel., Div. of Geol. Inf. Circ. 9, January 1937, 8 pp.

the principal producing areas. The following table gives production data for tripoli for 1932–36. The tonnage for 1919–36 is shown in figure 100.

The domestic production of tripoli is used principally for abrasives, fillers, and concrete admixture and the production of rottenstone for abrasives and fillers. In 1936 nearly 60 percent of the combined production of these two materials went into abrasive uses, and 11 percent was used as fillers. Over 7 percent of the tripoli produced was used in concrete admixtures. The following table presents statistics on the quantity and value of tripoli and rottenstone sold by producers and classified according to uses, as compiled from data furnished by the producers.

Tripoli sold or used by producers in the United States in 1936, by uses

Use	Number of producers reporting	Short tons	Value as sold (crude and finished)	Percent of total accounted for	
				Quantity	Value
Abrasives	5	16,943	$247,948	59.8	64.0
Concrete admixture	3	2,074	27,834	7.3	7.2
Filler	4	3,107	38,454	11.0	9.9
Foundry facing	2	(1)	(1)		
Miscellaneous	3	6,213	73,142	21.9	18.9
Total accounted for	[2] 7	28,337	387,378	100.0	100.0
Use not specified	1	150	4,500		
Grand total	8	28,487	391,878		

[1] Included under "Miscellaneous."
[2] A producer reporting more than 1 use is counted only once in arriving at total.

The companies reporting production and sales of tripoli (including Pennsylvania rottenstone) in the United States in 1936, with locations of the deposits from which the material was obtained, were as follows:

Barnsdall Tripoli Corporation, Seneca, Mo. Deposits at Seneca, Newton County, Mo., and in Ottawa County, Okla., near Seneca, Mo.

Corona Products, Inc. Deposit and office at Rogers, Benton County, Ark.

Friend, D. N., and Wheeler, H. R., Joplin, Mo. Deposit near Peoria, Ottawa County, Okla.

Independent Gravel Co., 220½ West Fourth Street, Joplin, Mo. Deposits at Racine, Newton County, Mo., and in Ottawa County, Okla., near Seneca, Mo.

Olive Branch Minerals Co., 333 Third Street, Cairo, Ill. Deposit at Olive Branch, Alexander County, Ill.

Ozark Minerals Co., 807½ Washington Avenue, Cairo, Ill. Deposit at Elco, Alexander County, Ill.

Penn Paint & Filler Co., Antes Fort, Pa. Deposit near Oriole, Lycoming County, Pa.

Western Talc Co., 1901 East Slauson Avenue, Los Angeles, Calif. Deposit near Barstow, San Bernardino County, Calif.

Quartz.—Quartz is the abrasive agent in some kinds of sandpaper, soaps, and scouring compounds, metal polishes, and safety matches. The material is obtained from pegmatite dikes, veins, or beds of quartzite. In 1936 the production of quartz from these sources in the United States amounted to 12,986 short tons valued at $96,592, a marked decrease in tonnage and value compared with 1935 and a still further decline from the recent peak year of 1934 when 18,293 tons valued at $129,965 were sold. Of the total production in 1936, about 48 percent was sold by the producers as crude or crushed quartz and 52 percent as ground quartz. Arizona, California, New Jersey, New York,

Ohio, and Tennessee have been constant producers in recent years. In addition to these States, Maryland, Missouri, North Carolina, Wisconsin, and Virginia have produced quartz 1 or more years.

Data covering sales of crude and ground quartz from 1932 to 1936 and sales of crude, crushed, and ground quartz by States from 1932 to 1936 are shown in the two following tables.

Quartz sold or used by producers in the United States, 1932–36

Year	Crude [1]		Ground [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1932	4,383	$15,394	[3] 3,104	[3] $43,764	[3] 7,487	[3] $59,158
1933	4,094	14,556	[3] 7,059	[3] 56,492	[3] 11,153	[3] 71,048
1934	4,447	16,168	13,846	113,797	18,293	129,965
1935	7,586	26,807	9,592	84,977	17,178	111,784
1936	6,281	24,971	6,705	71,621	12,986	96,592

[1] Includes some crushed quartz.
[2] To avoid duplication, the ground material shown here is only that ground by the original producers of the crude quartz or by grinders who purchase from small miners not reporting their production.
[3] Partly estimated.

Quartz (crude, crushed, and ground)[1] sold or used by producers in the United States, 1934–36, by States

State	1934		1935		1936	
	Short tons	Value	Short tons	Value	Short tons	Value
California	(2)	(2)	650	$2,600	(2)	(2)
Maryland	564	$6,390	405	6,075	525	$7,155
North Carolina	(2)	(2)	(2)	(2)	1,005	11,398
Undistributed [3]	17,729	123,575	16,123	103,109	11,456	78,039
	18,293	129,965	17,178	111,784	12,986	96,592

[1] To avoid duplication, the ground material included is only that ground by the original producers of the crude quartz or by grinders who purchase from small miners not reporting their production.
[2] Included under "Undistributed."
[3] 1934: Arizona, California, Missouri, New Jersey, New York, North Carolina, Ohio, Tennessee, and Virginia; 1935: Arizona, Missouri, New Jersey, New York, North Carolina, Ohio, and Tennessee; 1936: Arizona, California, New Jersey, New York, Ohio, and Tennessee.

The trend in the production of quartz for the past 9 years for which statistics are available is shown in figure 100.

A list of some recent producers and sellers of crude quartz follows:

Carolina China Clay Co., Penland, N. C.
Carolina Minerals Co., Inc., Spruce Pine, N. C.
Consolidated Feldspar Corporation, Trenton, N. J.
Day Quartz Co., Sykesville, Md.
H. O. DeBeck, Burnsville, N. C.
Harford Talc & Quartz Co., P. O. Box 63, Towson, Md.
Kingman Feldspar Co., Kingman, Ariz.
Ohio Quartz Products Corporation, Jackson, Ohio.
J. C. Pitman Estate, Penland, N. C.
C. F. Wolfradt, 319 South 8th Street, Alhambra, Calif.

A list of producers of crushed quartz follows:

Consolidated Feldspar Corporation, Trenton, N. J.
Harford Talc & Quartz Co., P. O. Box 63, Towson, Md.
Ohio Quartz Products Corporation, Jackson, Ohio.
Tennessee Mineral Products Corporation, Spruce Pine, N. C.

A list of manufacturers of ground quartz follows:

Charlotte Chemical Laboratories, Inc., Charlotte, N. C.
Consolidated Feldspar Corporation, Trenton, N. J.
Eureka Flint & Spar Co., Trenton, N. J.
Harford Talc & Quartz Co., P. O. Box 63, Towson, Md.
Tennessee Mineral Products Corporation, Spruce Pine, N. C.

Ground sand and sandstone.—Ground sand and sandstone are used as abrasives in various cleaning and scouring compounds; a third to a fourth of the total domestic production now enters abrasive compounds. The material so used is sold by companies producing glass sand and other special silica sands largely in the eastern and north-central United States; Illinois, New Jersey, Ohio, and Pennsylvania are among the largest producers.

The following tables give production data from 1932 to 1936 both for the United States as a whole and for such States as can be shown.

Ground sand and sandstone sold or used by producers in the United States, 1932–36 [1]

Year	Short tons	Value	Year	Short tons	Value
1932	150,109	$875,749	1935 [2]	281,665	$1,678,295
1933	202,099	1,106,410	1936	356,423	2,146,464
1934	248,026	1,392,173			

[1] Includes only finely ground material. Figures probably incomplete.
[2] Revised figures.

Ground sand and sandstone sold or used by producers in the United States, 1935–36, by States [1]

State	1935		1936	
	Short tons	Value	Short tons	Value
Illinois	66,492	$370,488	82,877	$483,952
Massachusetts	995	5,723	543	3,324
New Jersey	[2] 66,097	[2] 308,170	77,584	363,323
Ohio	[2] 62,730	[2] 454,947	46,314	339,211
Pennsylvania			(3)	(3)
Virginia and West Virginia	32,152	246,534	41,250	309,926
Undistributed [4]	53,199	292,433	107,855	646,728
	[2] 281,665	[2] 1,678,295	356,423	2,146,464

[1] Includes only finely ground material. Figures probably incomplete.
[2] Revised figures.
[3] Included under "Undistributed."
[4] 1935: California and Wisconsin; 1936: California, Missouri, Pennsylvania, and Wisconsin.

The trends in the production of ground sand and sandstone since 1919 are shown in figure 100.

The quantities of ground sand and sandstone sold for different uses and the values of the quantities so used, together with the average values per ton for each use are shown in the following table. These data, available for the first time, cover 69 percent of the industry.

Ground sand and sandstone sold or used by producers in the United States in 1936, by uses [1]

	Short tons	Value	
		Total	Average value per ton
Foundry	26,310	$143,733	$5.46
Pottery, porcelain, and tile	109,644	848,523	7.74
Enamel	19,220	110,454	5.75
Cleansing and scouring compound	58,057	266,314	4.59
Other abrasive use	10,874	48,702	4.48
Filler	9,325	49,825	5.34
Other	14,052	74,925	5.33
	247,482	1,542,476	6.23

[1] Data represent 69 percent of the industry.

The following companies reported production of ground sand and sandstone in 1936:

Central Silica Co., Zanesville, Ohio.
Cheshire White Quartz Sand Co., Cheshire, Mass.
Del Monte Properties Co., 401 Crocker Building, San Francisco, Calif.
Michigan Quartz Silica Co., Milwaukee, Wis.
Minnesota Mining & Manufacturing Co., St. Paul, Minn.
National Pulverizing Co., Millville, N. J.
National Silica Co., Oregon, Ill.
National Silica Works, Berkeley Springs, W. Va.
New Jersey Pulverizing Co., 205 West Thirty-fourth Street, New York, N. Y.
Ottawa Silica Co., Box 437, Ottawa, Ill.
Pennsylvania Glass Sand Corporation, Lewistown, Pa. (Grinds in New Jersey, Pennsylvania, and West Virginia.)
Pioneer Silica Products Co., R. F. D. 3, Pacific, Mo.
Potters Mining & Milling Co., East Liverpool, Ohio.
Shenandoah Silica Co., P. O. Box 266, Trenton, N. J.
Standard Flint & Spar Corporation, Trenton, N. J.
Standard Sanitary Manufacturing Co., Campo, Calif.
Standard Silica Co., Box 407, Ottawa, Ill.
Toledo Vitrified Brick Co., 1220 Madison Avenue, Toledo, Ohio.
Wedron Silica Co., 38 South Dearborn Street, Chicago, Ill.
White Rock Silica Co. of Wisconsin, Inc., Browntown, Wis.

Abrasive sand.—The production of sand in the United States for abrasive purposes depends largely upon conditions in the dimension-stone and plate-glass industries, and production in recent years has followed the general industrial trend—a peak of 1,636,464 short tons in 1929, a low of 419,691 tons in 1932, and recovery to 816,540 tons in 1935, with a total value of $1,198,653, and an average value of $1.47 a ton. Preliminary estimates indicate that of a total commercial production of sand and gravel of 119,660,000 tons in the United States in 1936 there were 960,000 tons of sand used for grinding and polishing having an average value of $1.38 and a total value of $1,320,000, a considerable increase over 1935. The relationships of abrasive sand to the rest of the sand and gravel industry are shown in the chapter on Sand and Gravel.

SPECIAL SILICA STONE PRODUCTS

Grindstones and pulpstones.—In 1936 most of the production of natural grindstones and pulpstones came from northeastern Ohio and western West Virginia; smaller quantities came from Skagit and Pierce

Counties, Wash. Both the quantity and value of sales of grindstones decreased compared with 1935. Sales of pulpstones in 1936 decreased in quantity but increased slightly in value.

The following table shows the sale of these materials from 1932 to 1936:

Grindstones and pulpstones sold by producers in the United States, 1932–36

Year	Grindstones		Pulpstones		
	Short tons	Value	Pieces	Short tons	Value
1932	6,001	$158,566	483	1,667	$88,874
1933	11,197	298,174	855	2,979	146,076
1934	9,781	285,603	760	2,849	177,631
1935	11,476	342,864	948	3,111	162,514
1936	10,703	334,363	685	2,472	163,634

The general downward post-war trend in output of grindstones from 1920 to 1932 was probably due to substitutions of manufactured abrasive wheels for natural grindstones. (See fig. 101.) Since

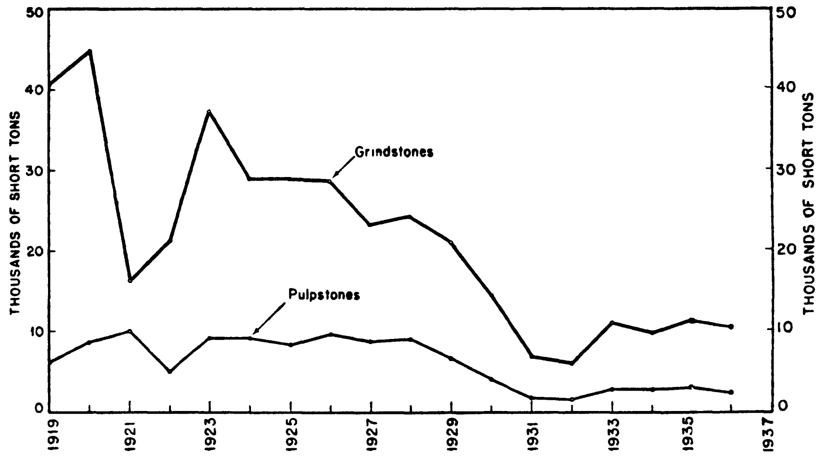


FIGURE 101.—Trends in production of grindstones and pulpstones in the United States, 1919–36.

1932, however, the production of grindstones has recovered moderately. Figure 101 also indicates that the production of pulpstones has fluctuated only slightly since 1919.

The companies reporting production of grindstones and pulpstones for commercial purposes in the United States in 1936, with locations of the quarries from which the stone was obtained, are as follows:

Briar Hill Stone Co. (grindstones). Quarry and office at Glenmont, Holmes County, Ohio.

C. & M. Quarries Co., Marietta, Ohio (pulpstones). Quarry at St. Marys, Pleasants County, W. Va.

Cleveland Quarries Co., Cleveland, Ohio (grindstones). Quarries at Amherst, Lorain County, Ohio; at Berea, Cuyahoga County, Ohio; and at Marietta, Washington County, Ohio.

Constitution Stone Co., Constitution, Ohio (grindstones and pulpstones). Quarries at Constitution, Washington County, Ohio; at Crow Summit, Jackson County, W. Va.

General Stone Co., Amherst, Ohio (pulpstones). Quarry at Opekiska, Monongalia County, W. Va.
Hall Grindstone Co. (grindstones). Quarry and office at Marietta, Washington County, Ohio.
Mount Pisbia Stone Co., Elyria, Ohio (grindstones). Quarry at Layland, Coshocton County, Ohio.
Nicholl Stone Co., Lorain, Ohio (grindstones). Quarry at Kipton, Lorain County, Ohio.
Ohio Valley Stone Co. (grindstones). Quarry and office at Marietta, Washington County, Ohio.
H. P. Scheel Co., Rockport, Wash. Quarry and office at Rockport, Skagit County, Wash.
Smallwood-Low Stone Co., Fairmont, W. Va. (pulpstones). Quarry in Monongalia County near Fairmont, W. Va.
Smallwood Stone Co., Union Trust Building, Cleveland, Ohio (pulpstones). Quarry at Opekiska, Monongalia County, W. Va.
Walker Cut Stone Co., Tacoma, Wash. (pulpstones). Quarry at Wilkeson, Pierce County, Wash.
West Virginia Pulpstone Corporation, Builders Exchange Building, Cleveland, Ohio (pulpstones). Quarry at Morgantown, Monongalia County, W. Va.

Oilstones and related products.—Sales of oilstones and related products of domestic origin were much greater in 1936 than in 1935 both in quantity and value; being greater in quantity than in any year since 1929 and in value since 1930. The oilstones sold were manufactured from novaculite quarried in Arkansas; the scythestones and whetstones were made from sandstone from Ohio and Indiana and schist from New Hampshire; and fine-grain sandstones quarried in Indiana and Ohio were used as raw materials for the manufacture of rubbing stones. There were two new producers in this group in 1936—the Bracher Agate & Abrasive Co., Summit, N. J., which manufactured oilstones from Arkansas novaculite, and Gil H. Wootten, Hot Springs, Ark., who produced oilstones in Garland County, Ark.

Oilstones and other whetstones, hones, scythestones, and rubbing stones sold by producers in the United States, 1932–36

Year	Short tons	Value	Year	Short tons	Value
1932	331	$63,960	1935	439	$105,589
1933	587	96,597	1936	752	121,196
1934	396	94,419			

The manufacturers of oilstones and other whetstones, scythestones, and rubbing stones from natural stone in 1936 with the sources of their raw materials, are as follows:

American Rubbing Stone Co., Cincinnati, Ohio (rubbing stones). Quarry at Floyds Knobs, Floyd County, Ind.
Bracher Agate & Abrasive Co., Summit, N. J. (oilstones). Manufactures stone obtained from Arkansas.
Cleveland Quarries Co., Cleveland, Ohio (scythestones, lathe stones, and holystones). Quarries at Amherst, Lorain County, Ohio, and at Berea, Cuyahoga County, Ohio.
Garland Whetstone & Kaolin Co., John C. Wolf, Hot Springs, Ark. (Produces rough stone, in Garland County, for oilstones, some of which is shipped abroad, and some of which is sold to manufacturers in this country.)
Lewis Whetstone Co., W. E. Lewis, Hot Springs, Ark. (Produces rough stone, in Garland County for oilstones, most of which is shipped to Germany.)
Norton Pike Co., Littleton, N. H. (oilstones, whetstones, and scythestones). Production from Pike, Grafton County, N. H.; Hot Springs, Garland County, Ark.; McDermott, Scioto County, Ohio; and West Baden, Orange County, Ind. (Quarries owned are in Arkansas and New Hampshire. Purchases stone from Ohio and Indiana.)

West Baden Whetstone Co. Quarries at West Baden, Ind. (Sells this stone to Norton Pike Co. Buys Arkansas and Ohio stone and manufactures it.)

Wootten, Gil H., Hot Springs, Ark. (oilstones). Produces rough stones in Garland County.

Millstones.—The downward trend in the value of natural millstones produced in the United States, which began in 1935 after 2 years of recovery from the low point of the depression in 1932, was stopped in 1936, and sales, which in 1935 had dropped to a value of $9,530, rose to $10,609 in 1936. The number of producers, which had reached 11 in 1935, is reported to have decreased to 9. Sales were confined to two States, New York with six producers and Virginia with only three. Production in 1936 was confined to millstones of conglomeratic and quartzitic types. Quarries yielding these types are known to have been in operation at two localities in the eastern United States—Ulster County, N. Y. (yielding the "Esopus" stone from the Shawangunk conglomerate), and Brush Mountain, Montgomery County, Va. (furnishing the "Brush Mountain" stone—a fine-grained quartzite). None of the granitic type of millstones, such as have come in recent years from Salisbury, Rowan County, N. C., are known to have been produced in 1936.

The following table presents annual production data for natural millstones and related products both for the United States as a whole and for the various States from 1932 to 1936.

Value of millstones, chasers, and dragstones sold by producers in the United States, 1932–36

Year	New York		Other States [1]		Total	
	Producers	Value	Producers	Value	Producers	Value
1932	5	$1,850	2	$2,600	7	$4,450
1933	7	5,187	2	3,200	9	8,387
1934	5	3,381	3	6,720	8	10,101
1935	8	4,645	3	4,885	11	9,530
1936	6	5,458	3	5,151	9	10,609

[1] 1932-35: North Carolina and Virginia; 1936: Virginia.

The following are names and addresses of the producers who reported sales of millstones and chasers of their own manufacture in the United States in 1936; the raw material from which the stones were made was obtained from Ulster County, N. Y.; and Montgomery County, Va.

Addis, Wilson C., Stone Co., R. D. 2, Kerhonkson, N. Y.
Coddington, George, Accord, N. Y.
Coddington, Oscar, Accord, N. Y.
Decker, Floyd, Kerhonkson, N. Y.
Esopus Millstone Co., High Falls, N. Y.
Laurence, Harry, Accord, N. Y.
Olinger, P. L. (Virginia Abrasive Co.), Blacksburg, Va.
Shealor, J. Fred (Virginia Millstone Co.), R. D. 2, Blacksburg, Va.
Snider, R. E., Cambria, Va.

Flint lining and grinding pebbles.—In certain American mineral industries that require a ground product with a minimum iron content, there is a continuing but moderate demand for noncontaminating grinding materials, such as flint lining and grinding pebbles. In recent years this demand has been met by two producers in the central and western United States. In 1936 there was only one producer of these materials—the Jasper Stone Co., Sioux City, Iowa—which

reported the sale of cut cubes and tube-mill liners made from quartzite quarried near Jasper, Rock County, Minn. This company reported better economic conditions in 1936 and a large increase in output. No beach pebbles from the Pacific Ocean front in San Diego County, Calif., were marketed in 1936, as in recent past years, as the business formerly conducted by John T. Momand was discontinued.

Pebbles for grinding and flint lining for tube mills sold or used by producers in the United States, 1932–36

Year	Short tons	Value	Year	Short tons	Value
1932	976	$13,070	1935	(1)	(1)
1933	3,709	47,011	1936	(1)	(1)
1934	(1)	(1)			

1 Bureau of Mines not at liberty to publish figures.

NATURAL SILICATE ABRASIVES

Pumice and pumicite.—Although commercial deposits of pumice and pumicite occur in many parts of the central and western United States, pumice—a cellular glassy lava was produced in 1936 only in California and New Mexico; and pumicite—finely divided glassy particles ejected during volcanic eruptions, known also as volcanic ash and volcanic dust—was produced in 1936 in California, Oklahoma, Kansas, and Nebraska. The pumice deposit near Grants, N. Mex., is said to yield a product similar to the Italian pumice.

Sales of pumice and pumicite in 1936 were considerably larger in both quantity and value than in 1935. The following table shows the quantity and value of pumice and pumicite sold or used by producers for 1932–36. The next table shows sales according to uses. Most of the material was used for cleansing and scouring compounds and hand soaps. Sales for concrete admixture and concrete aggregate were the second most important outlet, and showed a large increase over 1935. Sales for acoustic plaster were also larger than in 1935.

The trend in the production of pumice and pumicite during postwar years is shown in figure 100.

Pumice and pumicite sold or used by producers in the United States, 1932–36

Year	Short tons	Value	Year	Short tons	Value
1932	53,214	$235,204	1935 [1]	60,000	$247,076
1933	61,220	241,834	1936	72,915	328,406
1934	56,169	207,058			

1 Revised figures.

Pumice and pumicite sold or used by producers in the Uuited States, 1935–36, by uses

Use	1935			1936		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Cleansing and scouring compounds and hand soaps	50, 640	$176, 456	$3. 48	52, 270	$190, 581	$3. 65
Other abrasive uses (unspecified)	927	9, 438	10. 18	(1)	(1)	(1)
Concrete admixture and concrete aggregate	[2] 683	[2] 4, 776	[2] 6. 99	13, 959	55, 862	4. 00
Acoustic plaster	2, 860	37, 742	13. 20	3, 866	58, 789	15. 21
Miscellaneous uses [3]	[2] 4, 890	[2] 18, 664	[2] 3. 82	2, 820	23, 174	8. 22
	[2] 60, 000	[2] 247, 076	[2] 4. 12	72, 915	328, 406	4. 50

[1] Included with "Miscellaneous."
[2] Revised figures.
[3] 1935: Includes material used in asphalt, grading roads, chicken litter, filtering, manufacture of cement, rock gardens and landscaping, floor sweep, insecticide, and some unspecified uses; 1936: Includes material used in asphalt, grading roads, chicken litter, filtering, heat or cold insulating medium, other abrasive uses (unspecified), paints, floor sweep, and some unspecified uses.

The companies reporting production and sales of pumice and pumicite in the United States in 1936, with locations of the deposits from which the materials were obtained, were as follows:

Barnsdall Tripoli Corporation, Seneca, Mo. Deposit at Grants, Valencia County, N. Mex.

Basalt Rock Co., Inc. Deposit and office at Napa, Napa County, Calif.

Brown, Charles. Deposit and office at Shoshone, Inyo County, Calif.

Calaveras Cement Co., 315 Montgomery Street, San Francisco, Calif. Deposit at Wallace, Calaveras County, Calif.

California Quarries Corporation, 1300 Quinby Building, Los Angeles, Calif. Deposit in Mono County near Laws, Calif.

Chamberlain Co., Inc., 2550 East Ninth Street, Los Angeles, Calif. Deposit near Calipatria, Imperial County, Calif.

The Cudahy Packing Co., 221 North La Salle Street, Chicago, Ill. Deposits at Fowler, Meade County, Kans., and at Saltdale, Kern County, Calif.

The Davidson Pumice Co., Norton, Kans. Deposits at Calvert, Norton County, Meade, Meade County, and Natoma, Osborne County, Kans.

Dodson Concrete Board Co., 1463 Barwise Avenue, Wichita, Kans. Deposit at Wilson, Ellsworth County, Kans.

Friant Pumice Co., 816 Pacific Southwest Building, Fresno, Calif. Deposit in Madera County near Friant (Fresno County), Calif. (Successor to Bennett & Jourdan.)

La Rue Axtell Pumice Co., Eustis, Nebr. Deposits at Eustis, Frontier County, and Ingham, Lincoln County, Nebr.

Little Lake Pumice Co., 1204 South Monterey Street, Alhambra, Calif. Deposit near Little Lake, Inyo County, Calif.

Mid-Co Products Co., 238 Railway Exchange Building, Kansas City, Mo. Deposits at Meade, Meade County, and in Grant County near Satanta (Haskell County), Kans., and near Gate, Beaver County, Okla.

Pearl Pumice Quarries, Box 565, Monticello Way, Napa, Calif. Deposit near Napa, Napa County, Calif.

Pumicite Co., 4025 Clara Avenue, St. Louis, Mo. Deposit at Fowler, Meade County, Kans.

Red Eagle Placer Mining Claim (M. L. Francis), R. F. D., Creston, Calif. Deposit near Creston, San Luis Obispo County, Calif.

Tonopah & Tidewater Railway, 510 West Sixth Street, Los Angeles, Calif. Deposit at Shoshone, Inyo County, Calif.

Garnet.—The industrial recovery in the United States in recent years has resulted in a greater demand for garnet as an industrial abrasive. Production in 1936—3,820 tons with a value of $315,913—was nearly double the output and more than double the value in 1932,

the low point in abrasive-garnet production. There were increases of 25 percent in quantity and 23 percent in value in 1936 over 1935. Garnet was produced and marketed in 1936 in New York, New Hampshire, and North Carolina. Increased sales due to better business conditions were reported in both New York and New Hampshire. New York, which produced a grade of abrasive garnet recognized as the world standard, was the leading shipper. The garnet produced in North Carolina was recovered as a byproduct of kyanite operations. Production by individual States cannot be given because there were less than three producers in each.

Little interest was taken in 1936 in other possible garnet deposits in the United States because the productive capacity of existing plants exceeded trade demands.

Most of the garnet sold in 1936 was for use in the manufacture of garnet paper and cloth for the woodworking and shoe-manufacturing industries.

Prices of garnet concentrates were unchanged throughout 1936 from those at the end of 1935, according to quotations in the Engineering and Mining Journal (Metal and Mineral Markets). Adirondack (New York) garnet concentrates, f. o. b. mines, were constant at $85 a ton, and New Hampshire garnet concentrates, f. o. b. mines, remained at $30 a ton. Quotations for Spanish garnet, c. i. f. port of entry, were $60 a ton throughout 1936.

The following table shows the quantity and value of abrasive garnet sold or used by the producers since 1932.

Abrasive garnet sold or used by producers in the United States, 1932–36

Year	Short tons	Value	Year	Short tons	Value
1932	1,950	$147,350	1935	3,060	$256,520
1933	2,794	224,717	1936	3,820	315,913
1934	2,591	214,815			

The companies reporting sales of garnet in the United States in 1936, with locations of the deposits from which the garnet was obtained, are as follows:

Barton Mines Corporation, North Creek, Warren County, N. Y. Deposit on Gore Mountain, Warren County, N. Y.

Celo Mines, Inc., Burnsville, N. C. Recovered as a byproduct from kyanite mines near Burnsville, Yancey County, N. C.

Davenport Garnet Co., South Danbury, N. H. Deposit near Wilmot, Merrimack County, N. H.

Warren County Garnet Mills, Inc., 149 Orange Street, Newark, N. J. Deposit near Riparius, Warren County, N. Y.

Trends in production of garnet and artificial abrasives—silicon carbide and aluminum oxide—since 1920 compared with the Federal Reserve Board index of industrial production are shown in figure 102. The index of production of artificial abrasives has fluctuated about the index of industrial production but with increasing amplitude, whereas from about 1925 until 1932 the index of garnet sales fell farther below the industrial index. Since 1932 sales of garnet have responded to the industrial recovery, and the trend of the index of garnet sales has been upward.

NATURAL ALUMINA ABRASIVES

Corundum.—Corundum has not been mined in the United States since 1918, and so far as is known regular annual production ceased in 1906. The domestic demand for crude corundum in 1936 was satisfied by the importation of 4,790 short tons valued at $290,221, chiefly from the Union of South Africa. Imports have increased steadily in recent years from 188 tons in 1932. The corundum is exported from the Union of South Africa principally in the form of loose crystals and fragments more than one-eighth inch in size. Only small quantities of boulder corundum are exported. Virtually all the corundum exported from the Union of South Africa in 1935 came to the United States. Most of the material is obtained from deposits on farms in northern and northeastern Transvaal, where the corundum crystals are gathered by small-farm owners from the weathered outcrops of

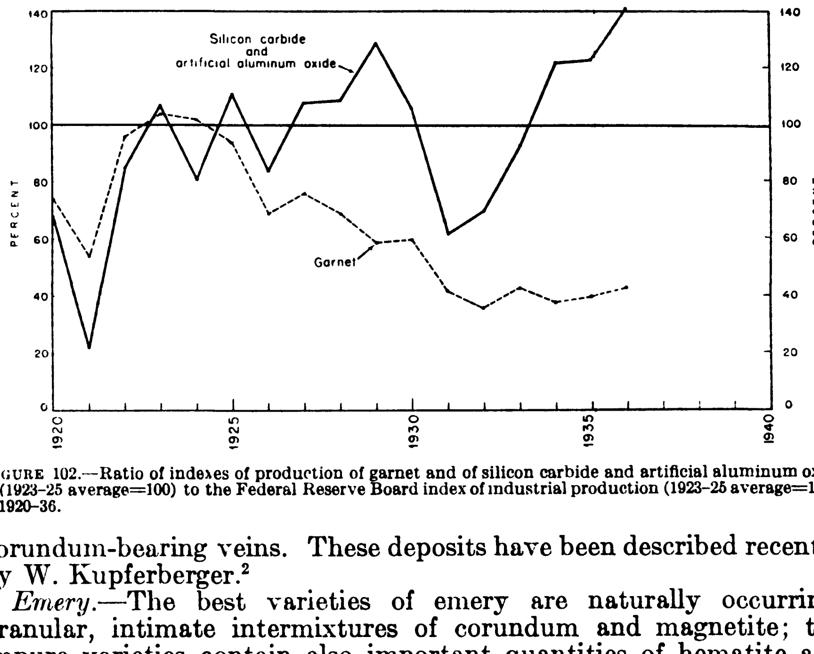


FIGURE 102.—Ratio of indexes of production of garnet and of silicon carbide and artificial aluminum oxide (1923–25 average=100) to the Federal Reserve Board index of industrial production (1923–25 average=100), 1920–36.

corundum-bearing veins. These deposits have been described recently by W. Kupferberger.[2]

Emery.—The best varieties of emery are naturally occurring, granular, intimate intermixtures of corundum and magnetite; the impure varieties contain also important quantities of hematite and spinel. Commercial deposits of emery occur in few localities in the United States, and production in recent years has been confined to a deposit of spinel-bearing emery near Peekskill, Westchester County, N. Y. The deposits in other localities have either been exhausted commercially or cannot under existing conditions meet the competition of domestic or imported Greek and Turkish emery.

Several theories have been suggested as to the origin of the Peekskill emery deposits, which are associated with the Cortlandt series of basic intrusives a short distance south and east of Peekskill. The most recent study,[3] by J. W. Butler, Jr., describes these deposits in detail and concludes that the emery was formed by emanations re-

[2] Kupferberger, W., Corundum in the Union of South Africa: Union of South Africa, Dept. Mines, Geol. Ser., Bull. 6, Pretoria, 1935, 81 pp., 1 text fig. (map), 1 pl. (geol. map).

[3] Butler, J. W., Jr., Origin of the Emery Deposits near Peekskill, N. Y.: Am. Mineral., vol. 21, no. 9, 1936, pp. 537–574.

leased by the basic magma during intrusion, the magmatic emanations passing through the Manhattan-schist country rock only a short distance ahead of the magma.

The general trend in domestic production of emery has been downward since the World War and reached the lowest point in many years in 1935, when shipments were only 176 short tons. In 1936 production increased, and 325 tons were reported sold. The quantity of emery sold or used by domestic producers from 1932 to 1936 is shown in the following table.

Emery sold or used by producers in the United States, 1932–36

Year	Short tons	Value	Year	Short tons	Value
1932	250	$2,781	1935	176	$1,606
1933	1,056	12,283	1936	325	2,900
1934	189	1,800			

Sales of emery in 1936 were reported by only one company: Smith & Ellis, Peekskill, N. Y.; deposit near Peekskill, Westchester County, N. Y. The emery mine formerly operated by the Keystone Emery Mills near Peekskill, Westchester County, N. Y., was leased to Joseph de Luca, Peekskill, N. Y., in 1935 but was not operated during 1935 or 1936.

NATURAL CARBON ABRASIVES

Abrasive or industrial diamonds.—Two types of industrial diamonds are used in the United States—black diamonds (carbonados) and bort—the present demand for which is met by importations. The black diamonds, which come chiefly from the State of Bahia (Brazil) are reputed to be harder than the gem varieties of diamond and are considered especially valuable for cutting tools because they have no cleavage. The other variety of abrasive diamond (bort) is obtained chiefly from the Union of South Africa and consists of cull stones from the gem-diamond industry. Imports of abrasive diamonds in 1936 were valued at $4,410,819, a slight increase over 1935, and included 3,779 carats of bort; 1,166,094 carats of glaziers', engravers', and miners' stones; and an unrecorded quantity of diamond dust valued at $2,537.

Diamonds have been produced commercially at only one locality in the United States—near Murfreesboro, Pike County, Ark. About 300 carats of gem stones and bort were recovered there in 1932, but no production is known to have been made there since. In 1936, however, considerable interest is stated to have been shown in the future development of this field as a result of the general recovery in business.

ARTIFICIAL ABRASIVES

Artificial abrasives may be divided into three main groups: (1) Metallic abrasives, such as crushed steel, steel shot, and steel wool; (2) metallic carbides, chiefly silicon carbide; and (3) synthetic aluminum oxide. The table that follows gives the production of silicon carbide, aluminum oxide, and metallic abrasives. These materials compete with the natural abrasives, such as emery, corundum, and garnet. The figures represent the total output of crude material,

that is, the crude abrasive material ready for sale as such or ready for the first step in its reduction to abrasive grain. The figures for 1936, which represent the crude product alone, are not strictly comparable with those of previous years, when several manufacturers included the value of grains or additional expenditures.

Crude artificial abrasives sold, shipped, or used, from manufacturing plants in the United States and Canada, 1932–36

Year	Silicon carbide [1]		Aluminum oxide [1]		Metallic abrasives		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1932	11,593	$1,066,064	18,835	$1,400,420	8,482	$410,264	38,910	$2,876,748
1933	16,606	1,715,989	30,778	2,436,962	6,844	381,314	54,228	4,534,265
1934	18,038	1,753,019	46,496	3,665,226	10,312	554,452	74,846	5,972,697
1935	24,266	2,164,728	49,990	3,784,726	14,593	741,633	88,849	6,691,087
1936	29,342	[2] 2,139,919	69,825	[2] 3,913,155	24,667	1,221,912	123,834	[2] 7,274,986

[1] Includes material used for refractories and other nonabrasive uses.
[2] Value of crude only, value of some grain included prior to 1936.

Not all the output of these materials is used for abrasive purposes. A large but undetermined part of the silicon carbide and aluminum oxide produced is used for refractory and other purposes not within the abrasive field. The total output is shown here because it is thought that the proportion used as abrasive material has not fluctuated so widely in recent years as to destroy the value of these figures for comparison with the statistics of natural abrasives.

Figure 102 shows the trends since 1920 in the combined production of silicon carbide and artificial aluminum oxide with reference to industrial production, as represented by the Federal Reserve Board index.

MISCELLANEOUS ABRASIVE MATERIALS

In addition to the materials already discussed several other commodities are used for abrasive purposes. These include a variety of oxides, silicates, and a carbonate. The oxides are all very fine grained materials and are used as final polishing agents. The oxides so used are tin oxide, or a mixture of tin oxide and oxalic acid, termed "putty powder"; rouge and crocus, forms of ferric oxide; chromium oxide; magnesium oxide or magnesia; manganese dioxide; and pure, high-grade lime. Silicates included in this miscellaneous group are river silt, clay (both natural and highly burned), and pulverized feldspar, all of which are utilized as abrasives, and clay and talc, which are used as polishing agents. Whiting (calcium carbonate) is used as a polishing agent.

FOREIGN TRADE [4]

The total value of abrasive materials imported for consumption in the United States in 1936 was $5,160,524, of which 85 percent was the value of industrial diamonds; the value of the imports was less than 1 percent higher than in 1935. Exports increased 5 percent in 1936, gains in abrasive wheels and other natural abrasives more than counter-balancing the decrease in the value of the exports of grindstones.

[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

The following table summarizes the value of the abrasive materials imported for consumption in the United States from 1932 to 1936; the quantity and value of imports from 1934 to 1936, by kinds; and the value of domestic materials exported from the United States from 1932 to 1936.

Abrasive materials imported for consumption in the United States, 1934–36, by kinds

Kind	1934		1935		1936	
	Quantity	Value	Quantity	Value	Quantity	Value
Millstones and burrstones:						
Rough or unmanufactured short tons	6	$483	1	$137		
Bound up into millstones do	17	1,689	19	1,927	24	$2,228
Grindstones, finished or unfinished do	379	14,085	598	20,895	815	24,638
Hones, oilstones, and whetstones do	68	35,143	101	53,563	87	41,252
Emery:						
Ore do	3,428	41,537	4,805	64,909	6,217	77,548
Grains, ground, pulverized, or refined pounds	(1)	(1)	(1)	(1)	(1)	(1)
Paper and cloth of emery or corundum pounds	(2)	26,185	(2)	22,747	(2)	18,215
Wheels, files, and other manufactures of which emery or corundum is the material of chief value pounds	81,131	47,882	108,382	62,506	136,966	78,677
Corundum (see also "Emery"):						
Ore short tons	2,187	134,884	5,056	309,194	4,790	290,221
Grains, ground, pulverized, or refined pounds	[1] 91,855	[1] 5,935	[1] 114,801	[1] 7,815	[1] 390,111	30,125
Tripoli and rottenstone do	1,587	37,853	1,590	24,925	522	11,759
Pumice:						
Crude or manufactured do	7,091	60,343	8,741	65,696	7,041	54,580
Manufactures of, or of which pumice is the component material of chief value short tons	(3)	22,929	(3)	32,536	(3)	29,931
Diamond:						
Bort carats	1,838	37,820	3,039	43,333	3,779	79,679
Dust pounds	(3)	31,162	(3)	54,858	(3)	2,537
Glaziers' and engravers', unset, and miners' carats	526,007	2,862,349	954,589	4,293,611	1,166,094	4,328,603
Flint, flints, and flint stones, unground short tons	5,154	45,602	8,768	66,727	9,910	90,531
		3,405,881		5,125,379		5,160,524

[1] Emery included with corundum; not separately classified.
[2] 2,956 reams in 1934, 2,507 reams in 1935, 2,494 reams in 1936; weight not recorded.
[3] Quantity not recorded.

Value of abrasive materials imported for consumption in the United States, 1932–36

Material	1932	1933	1934	1935	1936
Millstones and burrstones	$1,794	$1,123	$2,172	$2,064	$2,228
Grindstones	14,196	13,615	14,085	20,895	24,638
Hones, oilstones, and whetstones	15,543	29,968	35,143	53,563	41,252
Emery and corundum	107,199	170,921	256,423	467,171	494,786
Garnet	356	20			
Tripoli and rottenstone	39,055	57,029	37,853	24,925	11,759
Pumice	51,062	75,422	83,272	98,232	84,511
Diamond:					
Dust and bort	12,860	47,092	68,982	98,191	82,216
Glaziers' and engravers', unset, and miners'	1,061,823	1,263,156	2,862,349	4,293,611	4,328,603
Flint, flints, and flint stones, unground	27,217	29,485	45,602	66,727	90,531

Value of domestic abrasive materials exported from the United States, 1932–36

Material	1932	1933	1934	1935	1936
Grindstones	$85,528	$88,950	$143,626	$148,943	$140,614
Abrasive wheels, emery and other	64,069	213,087	113,118	116,376	124,471
All other natural abrasives, hones, whetstones, etc	147,469	158,812	254,515	250,228	277,463

SULPHUR AND PYRITES

By Robert H. Ridgway and A. W. Mitchell [1]

SUMMARY OUTLINE

Continued improvement in industrial activity throughout the world during 1936 was reflected in increased demand for sulphur. World production of native sulphur, supplemented by the recovery of elemental sulphur from sulphide ores and from the manufacture of fuel gases, increased substantially. Exports of crude sulphur from the United States, the principal supplier, increased 36 percent over 1935; production and exports from Japan also increased. Spain, Japan, and Norway were the principal producers of pyrites, but operations in the first country were hampered by the civil war.

Consumption of both sulphur and pyrites in the United States increased in 1936, and domestic production of pyrites rose to a new peak. In the sulphur industry the year was characterized by increased production, increased shipments, increased exports, and a steady price. Increases in severance taxes in the two principal producing States were of immediate concern to domestic producers in 1936. The following table outlines the principal features of the domestic situation in recent years.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Salient statistics of the sulphur industry in the United States, 1925–29 (average) and 1933–36

	1925-29 average	1933	1934	1935	1936
Sulphur:					
Production of crude sulphur long tons	1,951,034	1,406,063	1,421,473	1,632,590	2,016,338
Shipments of crude sulphur:					
For domestic consumption do	1,397,411	1,114,853	1,106,723	1,232,607	1,421,621
For export do	707,175	522,515	507,115	402,383	547,199
Total shipments do	2,104,586	1,637,368	1,613,838	1,634,990	1,968,820
Imports do	1,896	4,773	5,839	1,763	530
Exports of treated sulphur do	11,956	8,763	10,112	10,916	19,708
Producers' stocks at end of year do	2,413,000	3,300,000	3,100,000	3,100,000	3,100,000
Price of crude sulphur f. o. b. mines, per long ton	$17.50	$18	$18	$18	$18
Pyrites:					
Production long tons	273,936	284,311	432,524	[1] 514,192	547,236
Imports do	373,186	374,417	366,315	397,113	429,313
Price of imported pyrites c. i. f. Atlantic ports cents per long-ton unit	12-13	12-13	12-13	12-13	12-13
Sulphuric acid: Production of byproduct sulphuric acid (60° B.) at copper and zinc plants short tons	1,118,453	656,102	575,660	603,627	[2]

[1] Revised figures.
[2] Figures not yet available.

The total production of sulphur in the United States through 1936 has amounted to more than 38 million long tons. Virtually the entire output has been made since 1900. The principal trends in the domestic sulphur and pyrites industries during the twentieth century are shown in figures 103 and 104.

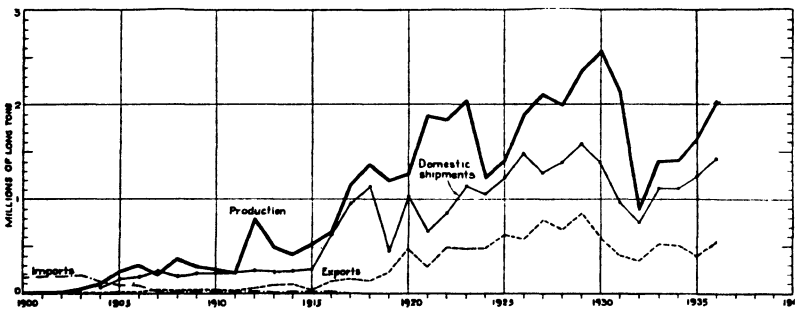


FIGURE 103.—Domestic production, domestic shipments, exports, and imports of crude sulphur, 1900–1936

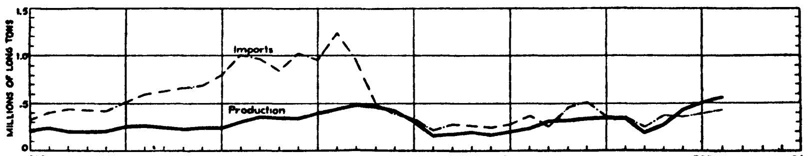


FIGURE 104.—Domestic production and imports of pyrites, 1900–1936.

SULPHUR

Domestic production.—Production of sulphur in the United States in 1936 totaled 2,016,338 long tons, an increase of 24 percent over the 1,632,590 tons produced in 1935. The 1936 output was the largest

since 1931. Shipments in 1936 were 1,968,820 tons, an increase of 20 percent over 1935 and the largest since 1930. The following table records American sulphur production and shipments from 1932 to 1936.

Sulphur produced and shipped in the United States, 1932–36

Year	Produced (long tons)	Shipped		Year	Produced (long tons)	Shipped	
		Long tons	Approximate value			Long tons	Approximate value
1932	890,440	1,108,852	$20,000,000	1935	1,632,590	1,634,990	$29,300,000
1933	1,406,063	1,637,368	29,500,000	1936	2,016,338	1,968,820	35,400,000
1934	1,421,473	1,613,838	28,900,000				

Eighty-five percent of the domestic output of sulphur reported for 1936 came from Texas and the bulk of the remainder from Louisiana. California and Utah produced only 4,947 long tons. Thus the two States, Texas and Louisiana, produced more than 99 percent of the domestic output.

The following table lists the sulphur mines in the United States active in 1936.

Mines that produced sulphur in the United States in 1936

Operating company	Name of mine	Location of mine
California:		
Sulphur Diggers, Inc.	Crater	Inyo County.
Sulphur Products Co.	Sulphur Queen	Do.
Louisiana.		
Freeport Sulphur Co.	Grande Ecaille	Plaquemines Parish.
Jefferson Lake Oil Co., Inc	Lake Peigneur	Iberia Parish.
Texas:		
Duval Texas Sulphur Co.	Boling Dome	Boling, Wharton County.
Freeport Sulphur Co	Hoskins Mound	Freeport, Brazoria County.
Texas Gulf Sulphur Co.	Big Hill Dome	Gulf, Matagorda County.
Do	Boling Dome	Newgulf, Wharton County.
Do	Long Point Dome	Long Point, Fort Bend County.
Utah: Utah Sulphur Industries	Utah Sulphur Industries.	Beaver, Beaver County.

Stocks.—Production exceeded shipments by a relatively small amount in 1936, resulting in a small increase in stocks. Such stocks, however, are large, amounting to 3,100,000 long tons on December 31, 1936.

Price.—The average quoted price for sulphur, as reported by trade journals, was unchanged at $18 a ton f. o. b. mines throughout 1936. Spot prices for carlots were quoted at $21 per ton.

Byproduct sulphuric acid.—Treatment of copper and zinc ores yields large quantities of sulphur, which are recovered at the mills as a pyrites concentrate or at the smelters as sulphuric acid. Production of pyrites concentrate is discussed in the pyrites section of this report. In smelting copper and zinc concentrates the sulphur is driven off as sulphur dioxide gas, which is used at many smelters in the manufacture of sulphuric acid. About 150,000 tons of sulphur were recovered as sulphuric acid annually from this source during the 5 years ended in 1935. Such sulphur is not included in the sulphur-production figures for the United States.

The following table gives the output of sulphuric acid as a byproduct at both copper- and zinc-smelting plants and represents virtually all

the byproduct acid produced in the United States. The acid reported is only that made from the sulphur content of the sulphide ores. The figures for 1934 and 1935 do not include the acid made from pyrites concentrate in Tennessee but do include the relatively small amount of acid made from pyrites concentrate in Wisconsin. For 1931–33 pyrites acid from both States is included. The figures for production of acid at copper plants exclude that made at Anaconda in 1933–35. Data for 1936 are not yet available.

Byproduct sulphuric acid (expressed as 60° B.) produced at copper and zinc plants in the United States, 1931–35, in short tons

	1931	1932	1933	1934	1935
Copper plants	436,111	258,994	[1] 301,075	[1 2] 168,676	[1 2] 160,151
Zinc plants	426,618	341,340	355,027	406,984	443,476
	862,729	600,334	[1] 656,102	[1 2] 575,660	[1 2] 603,627

[1] Excludes acid made by Anaconda Copper Mining Co. Part of the acid made by this company in 1931 and 1932 was from pyrites concentrate and all of the acid made in 1933–35 was from this source.
[2] Excludes acid made from pyrites concentrate in Tennessee.

Byproduct sulphur.—A small amount of byproduct sulphur is produced annually incident to the purification of manufactured fuel gas. In 1934, 1,500 long tons of sulphur were produced from this source. Only a minor part of the output is marketed; the remainder is stored or accumulated in dumps at the various plants. Such output is not included in the sulphur-production figures for the United States.

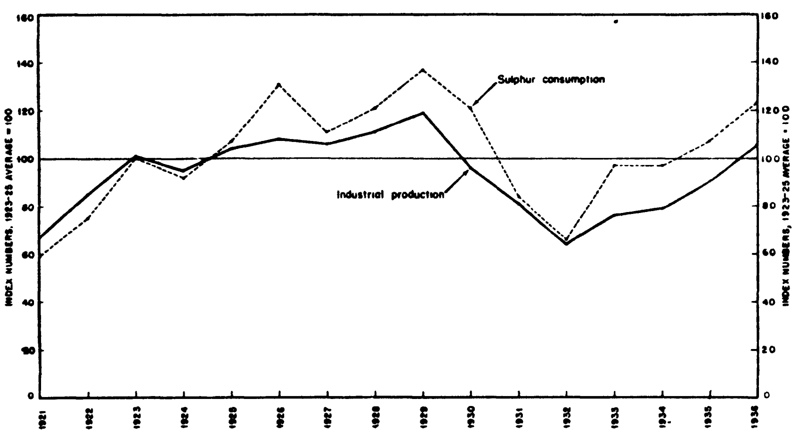


FIGURE 105.—Comparison of index of domestic sulphur consumption with the Federal Reserve Board index of industrial activity, 1921–36.

Consumption.—The diversified application of sulphur in industry tends to preserve a consumption commensurate with the general rate of business activity, as shown in figure 105 which compares the index of domestic sulphur consumption with that of industrial production as established by the Federal Reserve Board.

The apparent domestic consumption of sulphur in 1936 was greater than in any year since 1929. Sulphur consumption from 1932 to 1936 is shown in the following table, in which it is assumed that stocks in consumers' hands are small and constant.

Apparent consumption of sulphur in the United States, 1932–36, in long tons

	1932	1933	1934	1935	1936
Shipments	1, 108, 852	1, 637, 368	1, 613, 838	1, 634, 990	1, 968, 820
Imports		4, 773	5, 839	1, 763	530
	1, 108, 852	1, 642, 141	1, 619, 677	1, 636, 753	1, 969, 350
Exports:					
Crude	352, 610	522, 515	507, 115	402, 383	547, 199
Refined	7, 270	8, 763	10, 112	10, 916	19, 708
	359, 880	531, 278	517, 227	413, 299	566, 907
Apparent consumption	748, 972	1, 110, 863	1, 102, 450	1, 223, 454	1, 402, 443

The consumption of sulphur in various domestic industries from 1932 to 1936 has been estimated by Chemical and Metallurgical Engineering as follows:

Sulphur consumed in the United States, 1932–36, by uses, in long tons

Use	1932	1933	1934	1935	1936
Heavy chemicals	298, 000				
Electrochemicals	13, 000	491, 000	512, 000	555, 000	620, 000
Fine chemicals	10, 000				
Fertilizer and insecticides	155, 000	242, 000	247, 000	239, 000	266, 000
Pulp and paper	153, 000	197, 000	176, 000	204, 000	260, 000
Explosives	27, 000	37, 000	43, 000	42, 000	53, 000
Dyes and coal-tar products	34, 000	40, 000	34, 000	39, 000	46, 000
Rubber	18, 000	24, 000	30, 000	33, 000	39, 000
Paint and varnish	4, 000	4, 000	4, 000	48, 000	54, 000
Food products	4, 000	4, 000	4, 000	4, 000	4, 500
Miscellaneous	40, 000	75, 000	60, 000	68, 500	78, 000
	756, 000	1, 114, 000	1, 110, 000	1, 232, 500	1, 420, 500

Rather extensive research studies, principally by the major sulphur-producing companies, are being made on new uses for sulphur in industry and agriculture. Investigations into the use of sulphur as a fungicide and insecticide, as a fertilizer or soil conditioner, and in the control of weeds may lay the basis for expansion of its agricultural market. New and improved sulphur cements continued to attract attention during the year. Three such cements, designed particularly for making acidproof linings for tanks, acidproof floor joints, and leakproof and vibration-resisting bell joints in cast-iron and terra-cotta pipes, were reported in 1936.

Production of sulphuric acid, the chief use of sulphur in the United States, increased in 1936 over 1935, due to increases in a wide range of industrial uses. Consumption of sulphuric acid in the fertilizer industry paralleled increased demand for fertilizers as a result of a further rise in farm income. More than half the fertilizer made in the United States is phosphatic, and the bulk of the tonnage is superphosphate, virtually all of which is made by treating phosphate rock with an equal quantity of sulphuric acid. Experiments by Jacob [2] and associates have developed a process for producing calcined phosphate which, if applied to large-scale operation, may reduce the cost, per unit of available phosphorus, below the present cost of super-

[2] Jacob, K. D., Reynolds, D. S., and Marshall, H. L., Phosphate Fertilizers by Calcination Process—Volatilization of Fluorine from Phosphate Rock at High Temperatures: Amer. Inst. Min. and Met. Eng., Technol. Pub. 695, 1936, pp. 1–14.

phosphate. Typical superphosphate contains 16 to 20 percent available plant food, while calcined phosphate contains about 30 percent. Several small pilot plants now in operation use this process.

Higher concentrations of phosphate, commonly called triple superphosphate, have been made in the past but have not been well received by farmers, who never clearly understood its economic utilization.[3] This product was made by treating phosphate rock with low-strength phosphoric acid, which in turn was made by treating phosphate rock with sulphuric acid.

Although phosphoric acid has been produced in this country in the blast furnace and the electric furnace it has not been used to any great extent in fertilizer manufacture. During the past several years the Tennessee Valley Authority has been making higher-strength phosphate fertilizer, utilizing phosphoric acid made in the electric furnace, and has been testing the fertilizer on growing crops under various conditions in several Southern States. During 1936 the Tennessee Valley Authority developed what appears to be a satisfactory phosphatic fertilizer, calcium metaphosphate, with about 62 percent available plant food. A method has also been developed for making the plant food in phosphate rock available by fusion of the rock under proper conditions.[4]

Consumption of sulphuric acid in petroleum refining increased in 1936 over 1935, apparently reversing the trend in the 2 previous years. The following table, which shows the consumption of sulphuric acid by industries from 1932 to 1936, is based largely on estimates by Chemical and Metallurgical Engineering. The figures on acid consumed by the fertilizer industry are supplied by the Bureau of the Census.

Sulphuric acid (expressed as 50° B.) consumed in the United States, 1932–36, by industries, in short tons [1]

Industry	1932	1933	1934	1935	1936
Fertilizer [2]	771,000	1,206,000	1,396,000	1,343,000	1,463,000
Petroleum refining	1,240,000	1,140,000	1,100,000	980,000	1,100,000
Chemicals	674,000	725,000	910,000	940,000	985,000
Coal products	375,000	468,000	500,000	625,000	770,000
Iron and steel	270,000	390,000	475,000	630,000	700,000
Other metallurgical	310,000	360,000	400,000	520,000	600,000
Paints and pigments	160,000	170,000	330,000	400,000	450,000
Explosives	120,000	140,000	180,000	175,000	220,000
Rayon and cellulose film	176,000	219,000	256,000	309,000	337,000
Textiles	75,000	90,000	75,000	90,000	108,000
Miscellaneous	230,000	223,000	290,000	326,000	380,000
	4,401,000	5,131,000	5,912,000	6,338,000	7,113,000

[1] Figures, except those for fertilizer industry, from Chem. and Met. Eng., February 1937, p. 78, and from earlier annual review issues.

[2] Bureau of the Census, Department of Commerce.

Foreign trade.—Exports of sulphur during 1936 were greater than in any year since 1930; data by years from 1932 to 1936, inclusive, follow:

[3] Tennessee Valley Authority, Annual Report for the Fiscal Year Ended June 30, 1935: Washington, D. C., 1935, p. 60.

[4] Tennessee Valley Authority, Annual Report for the Fiscal Year ended June 30, 1936: Washington, D. C., 1936, p. 119.

Sulphur imported into and exported from the United States, 1932–36

Year	Imports for consumption [1]		Exports			
			Crude		Crushed, ground, refined, sublimed, and flowers of—	
	Long tons	Value	Long tons	Value	Long tons	Value
1932			352,610	$7,178,566	7,270	$266,210
1933	4,773	$67,432	522,515	9,877,879	8,763	316,890
1934	5,839	76,631	507,115	9,364,501	10,112	398,043
1935	1,763	26,164	402,383	7,582,293	10,916	418,532
1936	530	10,141	547,199	10,147,038	19,708	746,985

[1] Classified as "sulphur ore."

Exports by countries of destination during 1936 are shown in the following table:

Sulphur exported from the United States in 1936, by destinations

Destination	Sulphur or brimstone		Crushed, ground, refined, sublimed, and flowers of	
	Long tons	Value	Pounds	Value
North America:				
Canada	155,700	$2,838,563	5,915,048	$124,586
Central America	91	2,945	294,180	6,664
Mexico	9,355	189,006	1,846,463	36,505
Newfoundland and Labrador	7,578	140,970	3,800	137
West Indies	12,962	253,374	195,407	6,050
	185,686	3,424,858	8,254,898	173,942
South America:				
Argentina	3,500	66,500	17,247	1,337
Brazil	1,157	23,065	55,350	1,441
Colombia			350,465	8,976
Uruguay	1,014	18,250	8,800	854
Other	30	828	177,185	3,712
	5,701	108,643	609,047	16,320
Europe:				
Belgium	9,948	200,094	353,074	5,051
Denmark			1,254,301	16,521
France	73,660	1,371,489	866,480	11,836
Germany	42,534	851,260	1,431,017	18,450
Netherlands	19,711	397,618	584,224	7,240
Sweden	6,515	123,785	389,862	4,668
United Kingdom	79,004	1,379,299	5,260,347	64,133
Other	21,149	403,104	18,356,284	298,430
	252,521	4,729,649	28,495,589	426,329
Asia	4,974	91,882	1,971,432	46,075
Africa:				
Algeria	9,458	180,073		
Canary Islands			508	20
Mozambique			647,140	11,520
Union of South Africa	16,813	310,959	932,649	19,836
Other			301,256	4,926
	26,271	491,032	1,881,553	36,302
Oceania:				
Australia	57,536	1,041,154	2,723,626	41,874
New Zealand	14,510	259,820	208,853	6,143
	72,046	1,300,974	2,932,479	48,017
	547,199	10,147,038	44,144,998	746,985

THE INDUSTRY IN 1936, BY STATES

Texas.—Texas, with an increase of 37 percent over 1935, produced 85 percent of the total output of domestic sulphur in 1936—the largest since 1931. Six operations contributed to the total, but the largest output came from the Boling Dome property of the Texas Gulf Sulphur Co. The following table, compiled from information issued by the Texas State comptroller's office, shows the quarterly production of sulphur in Texas for 1936.

Sulphur produced in Texas in 1936, by companies, in long tons

Company	First quarter	Second quarter	Third quarter	Fourth quarter	Total
Texas Gulf Sulphur Co	295,802	277,094	339,323	374,126	1,286,345
Freeport Sulphur Co	64,120	70,390	75,637	109,080	319,227
Duval Texas Sulphur Co	29,687	37,188	21,378	30,459	118,712
	389,609	384,672	436,338	513,665	1,724,284

Effective November 1, 1936, the tax on the production of sulphur in Texas was increased from 75 cents to $1.03 per long ton.

The bulk of the output of the Texas Gulf Sulphur Co. came from Boling Dome in Wharton County, which has been operated continuously since first production on March 20, 1929. Production and shipments continued during 1936 from the smaller plant at Long Point, Fort Bend County. Operations at Gulf, Matagorda County, which were resumed on January 1, 1936, after the plant had been shut down for several years, were permanently discontinued in August 1936.

Although the Freeport Sulphur Co. permanently discontinued production at Bryan Mound in 1935, shipments were made from stocks during 1936, and production was continued at Hoskins Mound. The geology and operation at Hoskins Mound, which has produced more than 4,000,000 long tons of sulphur since the beginning of production on March 31, 1923, has been described by Marx.[5]

The Duval Texas Sulphur Co. continued to produce sulphur from its plant at Boling Dome in Wharton County. During the year this company was drilling for sulphur at Orchard Dome in Fort Bend County about 10 miles north of Rosenberg.

In 1936 the Jefferson Lake Oil Co. was prospecting for sulphur on certain tracts on Clemons Dome, Brazoria County, about 15 miles northwest of Freeport.

Louisiana.—Production of sulphur in Louisiana in 1936 totaled 288,099 long tons, a decrease of 23 percent from 1935. The bulk of the output came from the Grande Ecaille plant of the Freeport Sulphur Co. (279,660 tons according to the Supervisor of Public Accounts, State of Louisiana). A much smaller production (8,439 tons) was made by the Jefferson Lake Oil Co., Inc., at Jefferson Island salt dome. This property was abandoned in June 1936 and the plant dismantled after it had produced 425,902 tons.

The Louisiana State severance tax on sulphur was increased from 60 cents to $2 per long ton effective July 28, 1936.

California.—Two operators in Inyo County reported production of sulphur in 1936. A new concern, Sulphur Diggers, Inc., acquired

[5] Marx, Archer H., Hoskins Mound Salt Dome, Brazoria County, Tex.: Bull. Am. Assoc. Petrol. Geol. vol. 20, no. 2, February 1936, pp. 155–178.

the Crater group of claims in Inyo County in August 1936 and produced some sulphur in 1936; extensive development is planned during 1937.

Utah.—Sulphur production in Utah in 1936 came from the Utah Sulphur Industries plant at Beaver in Beaver County.

WORLD PRODUCTION

World production of sulphur in 1936, including elemental sulphur recovered in the treatment of pyrites and from gas manufacture in Germany, is estimated at 2,700,000 long tons. The following table table shows the output of the principal producing countries from 1932 to 1936.

Production of sulphur in the principal producing countries, 1932–36, in long tons

[Compiled by M. T. Latus]

Country	1932	1933	1934	1935	1936
Chile	11,770	12,558	20,356	19,792	(1)
Italy [2]	344,450	370,676	337,966	305,498	(1)
Japan [3]	83,195	112,619	133,273	162,341	172,545
Spain [4]	8,113	27,128	31,130	(1)	(1)
United States	890,440	1,406,063	1,421,473	1,632,590	2,016,338

[1] Data not available.
[2] In addition, the following quantities of ground rock are reported: 1932, 25,119 tons; 1933, 24,569 tons; 1934, 21,820 tons; 1935, 13,538 tons.
[3] In addition, the following quantities of sulphur rock are reported: 1932, 2,591 tons; 1933, 2,657 tons; 1934, 4,706 tons; 1935, 20,764 tons. Similar data are not available for 1936.
[4] Refined sulphur, exclusive of that made from imported crude sulphur.

Italy.—Italy, including Sicily, is the world's second largest producer of sulphur. Production and export figures for the calendar year 1936 are not yet available, but exports for the fiscal year ended July 31, 1936, were 205,045 long tons, of which 166,809 tons were from Sicily. The minimum prices of sulphur for the fiscal year 1936–37, guaranteed by the Central Sulphur Sales Bureau (Officio Vendita di Zolfo)[6] and established by Ministerial Decree of June 30, 1936, were:

Grade:	*Lire per ton*
Superior yellow	300
Inferior yellow	290
Common	278
Current	270

To furnish necessary credits to the sulphur industry, the head of the Government issued a decree late in 1936 authorizing the mining credit section of the Banca di Sicilia to increase the limit of its interest-bearing bonds from 40,000,000 to 50,000,000 lire.

Japan.—Sulphur production in Japan has been increasing during the past several years, and preliminary figures show that output in 1936 reached 172,545 long tons, the largest on record. Exports also increased to 70,853 tons in 1936 compared with 53,743 tons in 1935. The sulphuric-acid industry in Japan has been described by Matsui.[7]

Chile.—Production of sulphur in Chile is estimated at 25,400 long tons in 1936 compared with 19,792 tons in 1935. Exports, however,

[6] For information on the Central Sulphur Sales Bureau see Minerals Yearbook, 1934, pp. 920–921, and subsequent issues.
[7] Matsui, Mototaro, The Sulphuric Acid Industry in Japan: Jour. Soc. Chem. Ind., Japan, vol. 40, no. 2, February 1937, pp. 32B–36B.

declined from 14,822 long tons in 1935 to 10,769 tons in 1936. More than 75 percent of the 1936 exports went to other South American countries. Operations by the Cía. Azufrera y Minera del Pacifico, the largest producer, were resumed in January 1936, but at a reduced rate. The Caja de Credito Minero has established a sulphur refinery at Ollagüe on the Antofagasta & Bolivia Railway near the Bolivian frontier. The plant has a daily capacity of 100 tons of sulphur. High-grade ore containing 80 to 90 percent sulphur is sent directly to the steam autoclaves, and some of the sulphur is melted out. Low-grade ores (40 to 60 percent sulphur), together with gangue from the present autoclaves treating high-grade ore and tailings from the old sulphur refineries, are treated by flotation and the concentrates conveyed to the autoclave for refining. Recovery ranges from 40 to 80 percent.

Norway.—Data are not yet available on the output of sulphur in Norway in 1936, but the output may be estimated at 65,000 long tons. Exports in 1936 were 63,769 long tons and imports 15,509 tons. Production comes from the treatment of cupriferous pyrites at the Thamshavn plant of the Orkla Metal Co., a subsidiary of the Orkla Mining Co. Capacity of this plant will be doubled by additions now being made.

The following table, compiled from official sources, shows imports and exports of sulphur in Norway from 1931 to 1936.

Sulphur imported into and exported from Norway, 1931–36, in long tons [1]

Year	Imports	Exports			Year	Imports	Exports		
		Domestic	Other	Total			Domestic	Other	Total
1931	6,347	6,393		6,393	1934	10,997	63,766		63,766
1932	11,138	46,116	1	46,117	1935	14,149	65,125		65,125
1933	7,831	58,950		58,950	1936	15,509	63,769		63,769

[1] Manedsopgaver over Vareomsetningen med Utlandet.

Germany.—Germany has no production of native sulphur, and in the past its requirements have been met by imports, largely from the United States; imports in 1936 totaled 70,272 long tons. Much of the sulphur imported into Germany is transshipped to nearby countries; exports in 1936 were 36,931 tons. In recent years production of byproduct sulphur from the manufacture of various industrial gases has been increasing, and at present more than half of the domestic requirements are met from this source.

Spain.—The output of native sulphur in Spain is augmented by production of elemental sulphur obtained in the treatment of pyrites. Figures for 1936 are not available.

Sweden.—Elemental sulphur recovered as a byproduct from smelter gases at the Boliden plant at Ronskar in North Sweden is the only sulphur produced in Sweden. Production data for 1936 are not yet available, but the plant capacity has been given as 10,000 tons per year.

Portugal.—Production of elemental sulphur from pyrites at the San Domingos mine in the Province of Alemtejo, Portugal, was begun in 1935. The output in 1936 was 9,295 long tons; imports were 405 tons.

Other countries.—Less important quantities of sulphur are produced in Argentina, Bolivia, China, Ecuador, Greece, Mexico, Netherland India, New Zealand, Southern Rhodesia, and the U. S. S. R. (Russia).

PYRITES

Domestic production.—Production of pyrites (ores and concentrates) in the United States reached a record output of 547,236 long tons in 1936. The following table gives production from 1932 to 1936, inclusive.

Pyrites (ores and concentrates) produced in the United States, 1932–36

Year	Quantity		Value	Year	Quantity		Value
	Gross weight (long tons)	Sulphur content (percent)			Gross weight (long tons)	Sulphur content (percent)	
1932	189,703	35.0	$498,570	1935	[1] 514,192	[1] 39.5	[1] $1,583,074
1933	284,311	37.9	769,942	1936	547,236	39.6	1,666,194
1934	432,524	38.8	1,216,363				

[1] Revised figures.

Of the total output in 1936, 114,598 long tons were lump and the remainder fines; the bulk of the fines were flotation concentrates. The sulphur content of the pyrites produced in 1936 was 39.6 percent (216,592 tons of sulphur) compared with 39.5 percent (203,047 tons) in 1935.

The quantity of pyrites (ores and concentrates) sold or consumed by producing companies totaled 542,976 long tons in 1936 compared with 512,802 tons in 1935. In 1936, 181,494 tons were sold by producers compared with 163,911 tons in 1935. All sales in both years were to domestic consumers. Prices quoted by trade journals are for imported pyrites and are given in cents per long-ton unit c. i. f. Atlantic ports; the average quoted was 12 to 13 cents per long-ton unit throughout the year.

Tennessee was the principal producing State in 1936; other producers were California, Colorado, Illinois, Kansas, Missouri, Montana, New York, Virginia, and Wisconsin.

THE INDUSTRY IN 1936, BY STATES

California.—The Mountain Copper Co. was the only producer of pyrites in California in 1936; output came from the Hornet mine in Shasta County.

Colorado.—Shipments of pyrites continued from the mill-tailings dump of the Colorado zinc-lead mill in Lake County during 1936. The pyrites, which averaged 35 percent sulphur, was shipped to the Denver plant of the General Chemical Co., where it is used in the manufacture of sulphuric acid.

Illinois.—Two coal operators in Illinois, one in Christian County and one in Henry County, produced and shipped 9,472 long tons of pyrites (coal brasses) recovered as a byproduct in coal-cleaning operations. The pyrites was used in the manufacture of sulphuric acid.

Kansas.—The Mineral Products Co. produced 6,902 long tons of pyrites (coal brasses) in 1936 at West Mineral in Cherokee County.

Shipments, which averaged 47 percent sulphur, were consigned to St. Louis, Mo., where they were used in making sulphuric acid. A new plant for recovering pyrites from coal-mine refuse started operation in June 1936.

Missouri.—Production of pyrites in Missouri in 1936 was 27,293 long tons and came from Crawford, Franklin, and Phelps Counties.

Montana.—The pyrites produced in Montana in 1936 came from the Anaconda Copper Mining Co. at Anaconda, where it is recovered as a flotation concentrate in the copper-plant operation.

New York.—During 1936 the St. Joseph Lead Co. produced 62,530 long tons of pyrites concentrates at its Balmat mine in St. Lawrence County. The pyrites, which ran 49.57 percent sulphur, was produced as a flotation concentrate in the treatment of ore in which zinc is the principal value.

Tennessee.—The pyrites produced in Tennessee in 1936 came from operations of the Tennessee Copper Co. and the Ducktown Chemical & Iron Co., both in the Ducktown Basin, Polk County. The product is a flotation concentrate and does not enter the market, as both companies use their entire output in the manufacture of sulphuric acid. In the latter part of 1936 the Tennessee corporation took over the properties, plants, and inventories of the Ducktown Chemical & Iron Co.

Virginia.—The only pyrites mined in Virginia in 1936 came from the Gossan mine at Cliffview, Carroll County, operated by the General Chemical Co. The ore, both lump and fine, is mined by underground methods and is used in the manufacture of sulphuric acid in the company plant at Pulaski.

Wisconsin.—The only company reporting pyrites production in Wisconsin in 1936 was the Vinegar Hill Zinc Co., in Grant County, which makes a pyrites concentrate at its magnetic separation plant at Cuba City from ore from several mines in the Platteville district.

FOREIGN TRADE

Imports of pyrites in 1936 were the largest since 1929. Spain continued to supply the bulk of our imports, but in 1936 shipments of Spanish pyrites declined owing to the civil war. The drop in imports from Spain was offset by increased shipments from Canada and by shipments from Portugal. No pyrites were exported in 1935 or 1936.

Pyrites, containing more than 25 percent sulphur, imported into the United States, 1932–36, by sources

Country	1932		1933		1934		1935		1936	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Belgium									5,290	$29,756
Canada	12,070	$53,618	29,970	$131,940	19,341	$83,086	9,888	$45,965	55,105	200,184
Mexico							85	430		
Portugal									59,804	286,974
Spain	241,178	637,526	341,878	995,551	346,974	1,162,574	387,140	1,266,606	309,114	913,820
U. S. S. R. (Russia)			2,569	4,646						
	253,248	691,144	374,417	1,132,137	366,315	1,245,660	397,113	1,313,001	429,313	1,430,734

Imports of pyrites by customs districts during the past 5 years are shown on the following table:

Pyrites, containing more than 25 percent sulphur, imported into the United States, 1932–36, by customs districts, in long tons

Customs district	1932	1933	1934	1935	1936
Buffalo			44	94	140
Chicago				2,704	
Georgia		4,006	3,530	4,002	2,500
Los Angeles				848	
Maryland	100,434	136,113	162,183	182,333	172,290
New York	33,596	54,536	46,358	56,725	60,041
Ohio			12,668		
Philadelphia	95,640	135,392	116,361	129,793	158,088
San Diego				85	
South Carolina	4,008	6,700	11,541	7,681	9,429
Vermont	12,070	28,446	6,629	6,242	17,449
Virginia	7,500	7,700	7,001	6,606	9,376
Washington		1,524			
	253,248	374,417	366,315	397,113	429,313

If the recoverable sulphur content is calculated as 45 percent, the quantity of sulphur available in imported pyrites was approximately 195,000 long tons in 1936.

WORLD PRODUCTION

The following table shows world production of pyrites and its sulphur content. Most of the figures are taken from official sources of the countries concerned, supplemented by information from publications of the Imperial Institute and other reliable sources.

World production of pyrites (including cupreous pyrites), 1934–36, in metric tons

[Complied by M. T. Latus]

Country [1]	1934		1935		1936	
	Gross weight	Sulphur content	Gross weight	Sulphur content	Gross weight	Sulphur content
Algeria	13,600	6,270	12,350	5,681	19,965	9,184
Australia (Tasmania)	12,223	(2)	25,965	(2)	(2)	(2)
Bulgaria	20	(2)	(2)	(2)	(2)	(2)
Canada	10,040	4,990	26,494	13,174	115,404	57,305
China [3]	43,000	(2)	(2)	(2)	(2)	(2)
Chosen	40,024	(2)	55,611	(2)	(2)	(2)
Cyprus [4]	152,606	76,303	211,124	105,562	223,904	111,952
Czechoslovakia	17,920	7,527	20,000	8,400	(2)	(2)
Finland	71,167	32,950	83,023	37,391	(2)	(2)
France	161,060	70,220	150,130	67,059	(2)	(2)
Germany	230,149	99,065	290,188	124,466	(2)	(2)
Greece	150,950	72,998	(2)	(2)	(2)	(2)
Italy	812,396	379,605	833,405	377,971	(2)	(2)
Japan	1,090,487	436,195	1,311,468	524,587	1,692,624	677,050
Norway	960,898	424,718	893,513	395,549	(2)	(2)
Poland	11,996	5,278	732	322	(2)	(2)
Portugal	220,869	103,808	214,754	102,008	237,728	112,921
Rumania	4,001	1,641	9,855	5,080	(2)	(2)
Southern Rhodesia	11,714	4,674	12,232	4,877	19,447	(2)
Spain	2,072,413	817,413	2,286,113	(2)	(2)	(2)
Sweden	100,572	40,084	106,815	43,078	(2)	(2)
Union of South Africa	15,767	(2)	25,068	(2)	24,533	(2)
U. S. S. R. (Russia)	525,200	(2)	618,800	(2)	(2)	(2)
United Kingdom	2,179	(2)	4,261	(2)	(2)	(2)
United States	439,466	170,336	522,445	206,306	556,019	220,068
Yugoslavia	22,513	10,131	83,648	37,642	79,754	35,889

[1] In addition to countires listed, Belgium reports production, but figures are not shown separately.
[2] Data not available. [3] Includes Manchuria. [4] Exports.

Spain.—Spain is the principal world producer of pyrites, but war conditions undoubtedly restricted operations during 1936. Production and export figures are not available at this time.

Japan.—Preliminary figures show that the production of pyrites and cupriferous iron pyrite in Japan in 1936 was 1,692,624 metric tons. Production in recent years, which is all consumed locally, has been stimulated by increased demand for sulphuric acid.

Norway.—Production of pyrites is the principal mining industry in Norway, and output during 1936 may have reached 1 million tons. Exports were 746,080 metric tons in 1936, compared with 601,354 tons in 1935.

Portugal.—The production of pyrites in Portugal was 237,728 metric tons in 1936, compared with 214,754 tons in 1935. Exports increased from 123,961 metric tons in 1935 to 345,753 in 1936.

Canada.—Production of pyrites in Canada in 1936 totaled 115,404 metric tons containing 57,305 metric tons of sulphur, compared with 26,494 tons containing 13,174 tons of sulphur in 1935. Of the total output in 1936, 78,852 tons came from Quebec and 36,553 tons from British Columbia. In addition 11,789 short tons of auriferous pyrites concentrates were shipped to the Tacoma smelter from British Columbia for metal content and flux. Output from British Columbia came from the Britannia mill, where pyrites concentrate is produced in the treatment of ores for the extraction of copper. Quebec's production in 1936 came from the Eustis mine of the Consolidated Copper & Sulphur Co.

Canada also recovers sulphur in the form of sulphuric acid from nonferrous smelter gases. In 1936, 53,491 metric tons of sulphur were recovered as acid manufactured from smelter gases at Copper Cliff, Ontario, and at Trail, British Columbia. Elemental sulphur is also being recovered from smelter gases at Trail.

PHOSPHATE ROCK

By Bertrand L. Johnson and K. G. Warner

SUMMARY OUTLINE

The phosphate-rock industry in 1936 further increased mine production and shipments, reflecting the continued improvement in the fertilizer industry. Phosphate rock was mined and shipped in Florida, Tennessee, Idaho, and Montana and apatite in Virginia. Total shipments were the largest since 1930. Domestic consumption of phosphate rock continued to increase in 1936. Imports were small. Exports for the calendar year 1936 were somewhat larger than in 1935, but the trend of a 12-month moving total of monthly exports of phosphate rock turned downward late in 1936 and continued downward into 1937. Total stocks of phosphate rock in the hands of producers on December 31, 1936, were higher than those at the end of 1935. Quoted prices in the trade journals were unchanged throughout the year, although the trade reported a tendency for prices to soften.

Salient statistics of the phosphate-rock industry in the United States, 1934–36

	1934		1935		1936	
	Long tons	Value	Long tons	Value	Long tons	Value
Mined	2,898,238	(1)	[2] 3,159,328	(1)	3,462,837	(1)
Sold or used by producers:						
Florida:						
Land pebble	2,249,304	$7,466,087	2,269,891	[2] $7,751,954	2,454,272	$7,845,969
Soft rock	28,896	86,447	36,430	125,129	31,769	103,352
Hard rock	91,134	523,783	116,483	500,526	138,859	579,202
Total, Florida	2,369,334	8,076,317	2,422,804	[2] 8,377,609	2,624,900	8,528,523
Tennessee	[3] 425,952	[3] 1,815,678	[3] 550,284	[3] 2,323,536	[3] 643,822	[3] 2,598,279
Idaho	37,151	140,397	41,796	176,877	47,113	203,264
Montana	2,086	7,613	27,497	73,701	36,022	76,066
Virginia	(3)	(3)	(3)	(3)	(3)	(3)
Total, United States	2,834,523	10,040,005	3,042,381	[2] 10,951,723	3,351,857	11,406,132
Imports			3,699	29,729	3,100	17,187
Exports	993,493	5,008,532	1,104,394	5,773,506	1,208,951	6,744,462
Consumption, apparent [4]	1,841,030	(1)	1,941,686	(1)	2,146,006	(1)
Stocks in producers' hands, Dec. 31:						
Florida	871,990	(1)	[2] 1,069,860	(1)	1,155,000	(1)
Tennessee	[3] 165,480	(1)	93,440	(1)	173,000	(1)
Other	6,580	(1)	5,860	(1)	2,000	(1)
Total stocks	1,044,050	(1)	[2] 1,169,160	(1)	1,330,000	(1)

[1] No figures available.
[2] Revised figures.
[3] Virginia included with Tennessee.
[4] Quantity sold or used by producers plus imports minus exports.

Outstanding features of the domestic phosphate-rock industry for the past 15 years are shown graphically in figure 106. Production and exports reached their maximum in 1930, declined sharply in 1931 and 1932, and in the succeeding years recovered part of their loss. Imports reached a maximum of 45,812 long tons in 1928 and have since declined. Only 3,100 tons were imported in 1936. Stocks on hand at the end of the calendar year rose from 500,000 tons in 1925 to over a million tons in 1932 and 1934 and climbed still higher to 1,330,000 long tons in 1936 (higher than in any year since 1917). The general trend in stocks has been upward since 1925, with marked increases in 1926 and 1932.

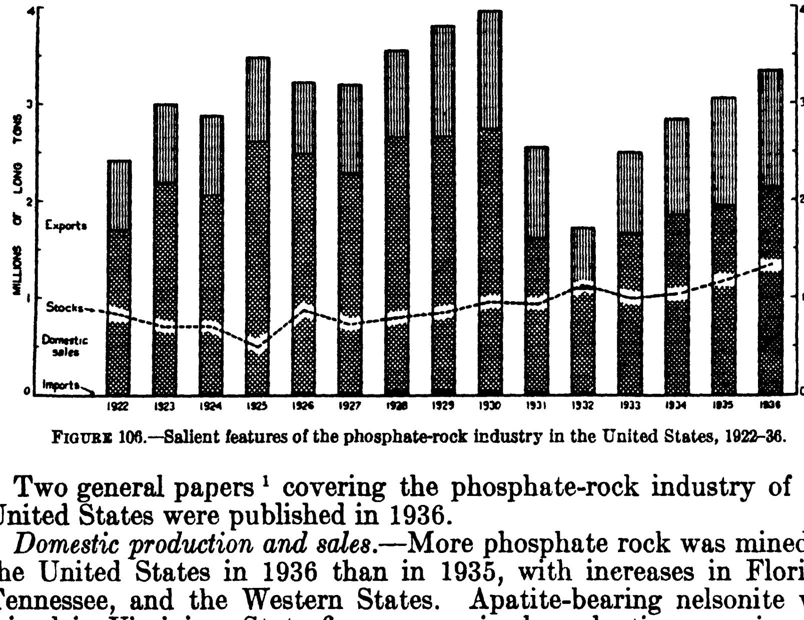


FIGURE 106.—Salient features of the phosphate-rock industry in the United States, 1922–36.

Two general papers [1] covering the phosphate-rock industry of the United States were published in 1936.

Domestic production and sales.—More phosphate rock was mined in the United States in 1936 than in 1935, with inereases in Florida, Tennessee, and the Western States. Apatite-bearing nelsonite was mined in Virginia. State figures on mined production are given in the following table.

Phosphate rock mined in the Un ted States, 1927–36, by States, in long tons

Year	Florida	Tennessee	Western States	United States	Year	Florida	Tennessee	Western States	United States
1927	2,626,177	457,154	44,324	3,127,655	1932	1,500,891	[1] 152,533	44,724	1,698,148
1928	2,909,264	573,265	40,827	3,523,356	1933	2,039,531	[1] 296,441	23,663	2,359,635
1929	3,100,505	647,711	39,039	3,787,255	1934	2,464,969	[1] 394,311	38,958	2,898,238
1930	3,361,786	607,814	66,597	4,036,197	1935	[2] 2,598,337	[1] 493,501	67,490	[2] 3,159,328
1931	2,155,903	393,925	116,681	2,666,509	1936	2,645,819	[1] 737,866	79,152	3,462,837

[1] Includes small quantity of apatite from Virginia.
[2] Revised figures.

[1] Jacob. K. D., Phosphate Rock (in 1935): Min. Ind., vol. 44, 1936, pp. 452–466.
Joint Committee of the Association of Land-Grant Colleges and Universities and of the Department of Agriculture, Report on The Conservation and Use of Our National Phosphate Resources for the Permanent Benefit of the American People: Presented at the November 1936 Meeting, at Houston, Tex., of the Association, 27 pp.

Phosphate rock sold or used by producers in the United States, 1932–36

Year	Long tons	Value	Year	Long tons	Value
1932	1,706,904	$5,738,493	1935	3,042,381	[1] $10,951,723
1933	2,490,312	7,872,362	1936	3,351,857	11,406,132
1934	2,834,523	10,040,005			

[1] Revised figures.

Shipments of domestic phosphate rock by grades were first shown in 1932. Similar data for 1935 and 1936 are given in the following table.

Phosphate rock produced in the United States and shipped in 1935–36, by grades, in long tons

B. P. L. content [1] (percent)	1935	1936	B. P. L. content [1] (percent)	1935	1936
Below 60	111,418	163,074	77 basis, 76 minimum } 77 minimum }	296,351	398,468
60 to 66	22,185	27,328			
68 basis, 66 minimum	564,395	470,407	Above 85 (apatite)	(4)	(4)
70 minimum	[2] 422,381	333,289	Undistributed	[2] 222,085	278,789
72 minimum	[2] 667,027	847,224			
75 basis, 74 minimum	[2] [3] 736,539	833,278		3,042,381	3,351,857
75 minimum	(3)		Total value	[2] $10,951,723	$11,406,132

[1] Bone phosphate of lime.
[2] Revised figures.
[3] 75 minimum grade included with 75 basis, 74 minimum.
[4] Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.

Distribution of sales by uses.—Phosphate rock is used chiefly in the manufacture of superphosphate, but considerable quantities are employed for other purposes. The following figures indicate the distribution of sales of phosphate rock by uses in the United States for the past 2 years.

Domestic phosphate rock sold by producers for consumption in the United States, 1935–36, by uses, in long tons

Use	1935	1936	Use	1935	1936
Superphosphates	[1] 1,690,554	1,768,677	Fertilizer filler	23,982	21,561
Phosphates, phosphoric acid, and ferrophosphorus	271,182	352,275	Stock and poultry feed	850	2,024
Direct application to soil	33,357	45,230	Undistributed	1,106	2,453
				[1] 2,021,031	2,192,220

[1] Revised figures.

Distribution of shipments by classes of consumers.—Figures compiled from reports by the producers show that of the total shipments of phosphate rock in the United States in 1936 (3,351,857 long tons valued at $11,406,132) 618,795 long tons valued at $2,046,301 were shipped to companies affiliated with the producers; 1,573,425 tons valued at $4,749,403 were shipped to other domestic consumers; and 1,159,637 tons valued at $4,610,428 were exported.

Prices.—Prices quoted by the Oil, Paint, and Drug Reporter for all grades of phosphate rock were unchanged throughout 1936, although the trade reported a tendency for prices to soften during the year. This tendency was probably due to the increasing stocks

of phosphate rock on hand; the declining trend in exports, shown by a 12-month moving total of monthly exports of phosphate rock; and the devaluation of certain European currencies during 1936.

Prices of Florida and Tennessee phosphate rock, f. o. b. mine, in 1936, per long ton [1]

Grade of rock (percent)	Price	Grade of rock (percent)	Price
Florida land pebble:		Florida high-grade hard rock:	
68 minimum	$1.85	77 basis, 76 minimum	$4.35
70	2.35	Tennessee brown rock:	
72	2.85	72	4.50
75 basis, 74 minimum	3.85	75	5.50

[1] Weekly quotations of Oil, Paint, and Drug Reporter for 1936.

Average values of shipments of various types of phosphate rock from mines or plants from 1932–36, inclusive, as computed from reports furnished to the Bureau of Mines by the producers, are shown in the following table.

Average value f. o. b. mine shipping point per long ton of phosphate rock shipped, 1932–36

[From reports of producers]

Year	Florida		Tennessee [1]	Idaho	Montana	United States
	Hard rock	Land pebble				
1932	$6.48	[2] $3.13	$4.01	$4.46	$3.95	$3.36
1933	6.63	2.91	4.11	4.08	2.52	3.16
1934	5.75	3.32	4.26	3.78	3.65	3.54
1935	4.30	[3] 3.42	4.22	4.23	2.68	[3] 3.60
1936	4.17	3.20	4.04	4.31	2.11	3.40

[1] Chiefly brown rock; includes apatite from Virginia.
[2] Includes small quantity of tailings.
[3] Revised figures.

REVIEW BY STATES

Florida.—In Florida, the leading phosphate-rock-producing State, land-pebble and hard-rock shipments in 1936 increased in quantity and value over 1935. The quantity and value of soft-rock shipments, however, were less in 1936 than in 1935.

The following companies produced land pebble in 1936:

Amalgamated Phosphate Co., 30 Rockefeller Plaza, New York, N. Y. Plant at Brewster.

The American Agricultural Chemical Co., 50 Church Street, New York, N. Y. Plant at Pierce.

Coronet Phosphate Co., 19 Rector Street, New York, N. Y. Plant at Coronet, near Plant City.

International Agricultural Corporation, 61 Broadway, New York, N. Y. Plant at Prairie, near Mulberry.

The Phosphate Mining Co., 110 Williams Street, New York, N. Y. Plant at Nichols.

Southern Phosphate Corporation, Baltimore Trust Building, Baltimore, Md. Plant at Ridgewood.

Swift & Co., Fertilizer Works, R. F. D. 1, Bartow, Fla. Plant at Agricola.

The following companies mined hard rock in 1936:

J. Buttgenbach & Co., Lakeland, Fla.

C. & J. Camp, Ocala, Fla.

Dunnellon Phosphate Mining Co., Savannah, Ga. Mine near Hernando, Citrus County.

The following companies reported the mining of soft rock in 1936:

The Colloidal Phosphate Sales Co., Dunnellon, Fla.
Connell & Shultz, Inverness, Fla.
The Dixie Phosphate Co., Ocala, Fla.
Loncala Phosphate Co., Ocala, Fla.
M. R. Porter, Ocala, Fla.
Soil Builders, Inc., Orlando, Fla.
Superior Phosphate Co., Dunnellon, Fla.

Florida phosphate rock sold or used by producers, 1932–36

Year	Hard rock			Soft rock		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1932	57,579	$373,251	$6.48	10,063	$24,017	$2.39
1933	52,382	347,324	6.63	[1] 16,841	[1] 48,802	2.90
1934	91,134	523,783	5.75	[1] 28,896	[1] 86,447	2.99
1935	116,483	500,526	4.30	[1] 36,430	[1] 125,129	3.43
1936	138,859	579,202	4.17	[1] 31,769	[1] 103,352	3.25

Year	Land pebble			Total		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1932	[2] 1,402,334	[2] $4,382,344	[2] $3.13	1,469,976	$4,779,612	$3.25
1933	2,066,900	6,020,984	2.91	2,136,123	6,417,110	3.00
1934	2,249,304	7,466,087	3.32	2,369,334	8,076,317	3.41
1935	2,269,891	[3] 7,751,954	[3] 3.42	2,422,804	[3] 8,377,609	[3] 3.46
1936	2,454,272	7,845,969	3.20	2,624,900	8,528,523	3.25

[1] Includes material from waste pond operations.
[2] Includes small quantity of tailings.
[3] Revised figures.

Cash[2] and Dempsey discussed accident experience in the land-pebble industry. Roundy[3] and Mansfield described the geology of the hard-rock and land-pebble deposits and the methods used in prospecting public lands in these fields.

South Carolina.—Some interest was taken during 1936 in the reopening of the phosphate-rock deposits of the coastal region of South Carolina, and the General Phosphate Corporation, Beaufort, S. C., is reported to have been formed to develop phosphate deposits in the area between the Broad and Coosaw Rivers and the Atlantic Ocean.

Tennessee.—Tennessee, which ranks next to Florida as a phosphate rock-producing State, continued to recover in 1936 from the low point of 1932. Most phosphate rock marketed in 1936 came from the brown-rock fields of Maury, Sumner, Giles, Davidson, and Hickman Counties. Considerable blue rock was shipped from Lewis and Hickman Counties and a little white rock from Perry County. The

[2] Cash, F. E., and Dempsey, C. P., Pebble Phosphate Accident Experience: Inf. Circ. 6917, Bureau of Mines, October 1936, 10 pp.
[3] Roundy, P. V., and Mansfield, G. R., Government Prospecting for Phosphate in Florida: Am. Inst., Min. and Met. Eng., New York Meeting, February 1937, 4 pp.

quantity and value of shipments of Tennessee phosphate rock in 1936 were greater than in 1935. Stocks on hand December 31, 1936, were greater than a year earlier.

Tennessee phosphate rock [1] sold or used by producers, 1932–36

[Includes apatite from Virginia]

Year	Long tons	Value at mines: Total	Value at mines: Average	Year	Long tons	Value at mines: Total	Value at mines: Average
1932	193,666	$776,367	$4.01	1935	550,284	$2,323,536	$4.22
1933	333,946	1,373,392	4.11	1936	643,822	2,598,279	4.04
1934	425,952	1,815,678	4.26				

[1] Separate figures for brown rock and blue rock cannot be given without disclosing confidential data regarding blue-rock production.

The following phosphate-rock concerns were operating in Tennessee in 1936.

Armour Fertilizer Works, Room 816, Walton Building, Atlanta, Ga.
Chaffin & Williams, Mountpleasant, Tenn.
Charleston Mining Co., Inc., 627 East Main Street, Richmond, Va.
J. K. Davis, Mountpleasant, Tenn.
Federal Chemical Co., Inc., 634 Starks Building, Louisville, Ky.
W. T. Hackney, Mountpleasant, Tenn.
Harsh Phosphate Co., R. F. D. 7, East Station, Nashville, Tenn.
Hoover & Mason Phosphate Co., 8 South Michigan Avenue, Chicago, Ill.
W. T. Huff, Mountpleasant, Tenn.
International Agricultural Corporation, Columbia, Tenn.
Kimbro & Worley, Centerville, Tenn.
Monsanto Chemical Co., 1700 South Second Street, St. Louis, Mo.
Sharp & Hackney, Columbia, Tenn.
Tennessee Valley Authority, Knoxville, Tenn.

Tennessee's share of the domestic market for phosphate rock in post-war years has ranged from 17.5 percent in 1932 to 30.0 percent in 1936. It has increased steadily from 1932 to 1936, when it exceeded any previous post-war year.

Ratio of Tennessee output to total domestic consumption of phosphate rock, 1910–14 and 1921–36

Year	Percent	Year	Percent
1910–14 (average)	23.2	1933	20.0
1921–25 (average)	18.9	1934	23.1
1926–30 (average)	21.6	1935	28.3
1931	21.5	1936	30.0
1932	17.5		

Interest in Tennessee phosphate rock in 1936 was centered in the activities of the Monsanto Chemical Co. and the Tennessee Valley Authority. Early in the year the Monsanto Chemical Co. started to develop a tract of phosphate-bearing land and during the year completed the erection of a phosphate-rock sintering plant, the product of which was shipped to the electric furnaces of the company at Anniston, Ala. Late in the year this company started to erect electric furnaces near Columbia, Tenn., for the production of phosphoric acid. Mining was begun by the company in 1936 in the brown-rock field near

Columbia, Tenn.,[4] and bottom-dump tractor trucks were used to haul the phosphate rock from the mine pit to the plant.

The Tennessee Valley Authority had several thousand acres of phosphate-bearing land under lease in central Tennessee, in Sumner, Perry, and Maury Counties, and during 1936, the rock on these lands was mined under contract and shipped to Muscle Shoals, Ala., mostly by rail but in the case of Perry County rock, by barge up the Tennessee River. Some phosphate-bearing lands were bought outright by the Tennessee Valley Authority in 1936 to insure future supplies of the rock. The Authority continued the erection of a 154-kilovolt transmission line 65 miles long from Wheeler Dam to Kraus Station, north of Columbia, where a large substation is to be erected. This line will provide current for the large load of the Monsanto Chemical Co. and service for future developments in the middle Tennessee area.

At Muscle Shoals, Ala., the Tennessee Valley Authority had two electric furnaces in service 233 days during the fiscal year ended June 30, 1936, and produced 28,690 tons of triple superphosphate and 292 tons of ferrophosphorus. A third electric furnace is being converted to utilize phosphate-rock "fines." During the fiscal year ended June 30, 1936, 31,338 tons of concentrated fertilizer which contained about 45 percent available plant food were distributed (1,986 tons the previous year), principally in the Tennessee Valley for tests and demonstrations under practical farm conditions.

In addition to the triple superphosphate the following materials were produced by the Authority during the fiscal year ended June 30, 1936 and shipped to agricultural experiment stations for testing as fertilizer: Monocalcium phosphate, 2.95 tons; dicalcium phosphate, 10 tons; calcium metaphosphate, 10.5 tons; fused phosphate rock, 14.8 tons; ground slag, 134.5 tons; and granulated slag, 3.5 tons. Laboratory research was in progress both at Muscle Shoals and the University of Tennessee at Knoxville on problems related to the development and production of new concentrated plant foods, especially phosphates.

The preparation of phosphoric acid, triple superphosphates, and other products at the T. V. A. plant at Wilson Dam, Ala., is described in detail in three reports.[5]

Virginia.—The Southern Mineral Products Corporation (subsidiary of the Vanadium Corporation of America) continued to develop the nelsonite deposit at Piney River and produced apatite and ilmenite. During the year this company sold its chemical unit to the Virginia Chemical Co., but retained its nelsonite ore deposits and milling and concentrating plant at Piney River.

Western States.—In 1936, as in 1935, only two phosphate-rock-producing companies were operating in the Western States, one in Idaho and one in Montana. The quantity and value of the phosphate rock marketed in each State were greater than in 1935.

Idaho was the larger producing State. Most of the rock produced came from the Conda No. 1 mine of the Anaconda Copper Mining Co., Conda, Caribou County, Idaho, but a considerable quantity came

---

[4] Church, H. K., Big-Capacity Tractor Trucks Haul Phosphate Rock from Pit to Plant: Pit and Quarry vol. 29, no. 9, 1937, pp. 65–66.

Sup
647–650.

Curtis, H. A., Copson, R. L., and Abrams, A. J., Metaphosphate Investigation Aims at Cheaper Fertilizers: Chem. and Met. Eng., vol. 44, no. 3, 1937, pp. 140–142.

from the Conda No. 3 mine. According to the company's annual report,[6] 22,589 tons of treble superphosphate and phosphoric acid were produced at Anaconda, Mont., in 1936. A small quantity of the phosphate rock from this property was sold for direct application to the soil, and a little was exported.

In Montana the Montana Phosphate Products Co., Trail, British Columbia, operated the Anderson mine near Garrison, Powell County, under contract with William Anderson and shipped the phosphate rock mined to Canada. According to the annual report of the Consolidated Mining & Smelting Co. of Canada, Ltd.,[7] 40,345 short tons (36,022 long tons) of phosphate rock were produced at this property in 1936 and 165 feet of drifts and 598 feet of raises driven during the year.

A detailed description of the phosphate-rock deposits near Maxville, Philipsburg, and Avon, Mont., by J. T. Pardee, of the United States Geological Survey, was published during 1936.[8] This report covers the geology, composition, reserves, development, treatment, production, and markets of the phosphate rock in several of the productive phosphate-rock areas of the State.

Western States phosphate rock sold or used by producers, 1932–36

Year	Idaho			Montana			Total		
	Long tons	Value at mines		Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average		Total	Average
1932	23,172	$103,243	$4.46	20,090	$79,271	$3.95	43,262	$182,514	$4.22
1933	19,751	80,622	4.08	492	1,238	2.52	20,243	81,860	4.04
1934	37,151	140,397	3.78	2,086	7,613	3.65	39,237	148,010	3.77
1935	41,796	176,877	4.23	27,497	73,701	2.68	69,293	250,578	3.62
1936	47,113	203,264	4.31	36,022	76,066	2.11	83,135	279,330	3.36

FOREIGN TRADE[9]

Imports.—In recent years relatively little phosphate rock has been imported into the United States. In 1928 imports of phosphate rock reached a post-war maximum of 45,812 long tons, but they have since declined, and in 1934 no phosphate rock was imported into this country. Imports in 1935 and 1936 were confined almost solely to shipments from the U. S. S. R. (Russia), amounting to 3,699 and 3,100 long tons, respectively. The following table shows imports of phosphate rock from 1932 to 1936 by countries:

[6] Anaconda Copper Mining Co., Report for the Year Ended December 31, 1936.
[7] Consolidated Mining & Smelting Co. of Canada, Ltd., Thirty-first annual report, for the 12 months ended Dec. 31, 1936.
[8] Pardee, J. T., Phosphate Rock Near Maxville, Philipsburg, and Avon, Mont.: U. S. Geol. Survey Bull. 847, 1936, pp. 175–188.
[9] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Phosphate rock, crude, imported into the United States, 1932-36, by countries [1]

Country	1932		1933		1935		1936	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Germany	25	$160					(2)	$15
Oceania: French	6,300	69,741	5,625	$59,409				
U. S. S. R. (Russia)	[3] 6,607	[3] 23,808			[4] 3,699	[4] $29,729	[3] 3,100	[3] 17,172
United Kingdom	50	138						
West Indies: Netherland			2,100	13,188				
	12,982	93,847	7,725	72,597	3,699	29,729	3,100	17,187

[1] None reported in 1934.
[2] Less than 1 ton.
[3] Apatite.
[4] Includes 3,599 long tons valued at $28,829 known to be apatite.

Phosphatic fertilizers other than phosphate rock imported for consumption in the United States include various bone products, guano, and basic slag. In 1936 the quantity and value of imports of basic slag were slightly less than in 1935, while the quantity and value of imports of the other groups increased. Imports for 1932-36 are given in the following table:

Phosphatic fertilizers (other than crude phosphate rock) imported for consumption in the United States, 1932-36

Fertilizer	1932		1933		1934		1935		1936	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Bone dust, or animal carbon, and bone ash, fit only for fertilizing	30,118	$508,802	28,500	$519,982	15,948	$308,873	18,388	$354,900	23,215	$465,585
Guano	24,231	489,992	59,772	1,118,268	16,638	337,136	16,219	311,645	22,804	457,209
Slag, basic, ground or unground	2,189	21,005	863	10,698	131	2,009	1,078	15,136	758	9,758
Precipitated bone fertilizer grade							472	11,613	3,817	96,166

Exports.—Exports in 1936 continued the upward movement started in 1933, increasing in quantity and value. The average value per ton of the phosphate rock exported increased from $5.23 in 1935 to $5.58 in 1936.

Phosphate rock, ground or unground, not acidulated, exported from the United States, 1932-36

Year	Long tons	Value	Year	Long tons	Value
1932	613,035	$2,795,654	1935	1,104,394	$5,773,506
1933	829,059	3,544,377	1936	1,208,951	6,744,462
1934	993,493	5,008,532			

Exports of land-pebble and other phosphate rock in 1936 increased in quantity and value over 1935. Shipments to Belgium increased sharply, and those to Canada, Germany, Japan, Sweden, and the United Kingdom also were higher, while exports to Spain dropped.

Exports of high-grade hard rock likewise increased in quantity and value, principally because of increased takings by Germany. The following table shows the total exports of high-grade hard rock, land-pebble, and other phosphate rock, also shipments of each type of rock to various foreign countries annually from 1932 to 1936.

Phosphate rock, ground or unground, not acidulated, exported from the United States, 1932–36, by countries

HIGH-GRADE HARD ROCK

Country	1932		1933		1934		1935		1936	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Australia					2,133	$16,471				
Belgium	7,100	$46,150			5,325	37,275			4,300	$30,100
British West Indies ("Other")							2	$40		
Canada	29,469	156,652	977	$7,303	823	8,628	28,907	121,686	39,271	242,479
Cuba			97	957						
Germany	9,590	67,130	24,840	173,092	38,100	266,700	49,880	349,160	72,400	507,950
Lithuania	11,500	80,500	11,000	77,000	7,000	49,000	6,000	42,000		
Netherlands	1,650	11,550	2,750	19,250	14,600	102,200	19,575	137,025	15,050	115,350
Panama					1	31	4	31		
Poland and Danzig	2,500	16,250	2,700	17,550					7,700	53,900
Sweden	4,200	27,300			29,630	192,595	25,700	169,075	25,225	174,350
	66,009	405,532	42,364	295,152	97,612	672,900	130,068	819,017	163,946	1,124,129

LAND PEBBLE AND OTHER

Country	1932		1933		1934		1935		1936	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Austria							3,000	$15,750	3,001	$15,005
Belgium			9,764	$39,812	4,986	$30,804	3,293	16,794	77,972	478,384
British West Indies ("Other")					5	99				
Canada	18,723	$94,830	14,210	51,102	28,650	164,939	29,562	160,028	37,853	165,166
Cuba	27	390	62	321						
Czechoslovakia			2,998	14,540					5,983	30,114
Denmark	21,337	90,483	28,696	116,453	32,013	143,817	36,186	159,242		
Finland					3,500	14,875				
France	2,197	9,144	2,750	6,875	3,006	15,480	3,671	20,374		
Germany	68,058	311,280	130,446	587,678	143,882	740,458	211,179	1,157,410	278,404	1,660,508
Hungary									4,852	24,163
Italy	65,523	292,173	87,767	384,690	106,760	571,107	60,643	359,123	65,813	393,657
Japan	143,446	520,095	157,362	485,527	213,620	880,824	222,110	952,974	281,797	1,176,953
Latvia			13,144	64,173						
Netherlands	96,507	436,875	153,130	639,662	158,629	792,600	147,769	812,060	142,432	904,135
Norway	300	1,050					1,499	11,243		
Panama	1	20								
Poland and Danzig	6,386	33,875	20,418	114,450	34,994	219,081	28,499	176,781	16,654	93,428
Rumania							11,298	56,490	12,852	64,260
Spain	77,696	360,697	73,178	327,715	89,226	412,799	140,329	668,454	28,720	151,789
Sweden	41,325	214,102	63,720	299,836	41,645	188,532	29,738	165,491	45,664	291,870
United Kingdom	2,200	10,120	27,400	108,141	22,693	97,419	28,659	126,776	43,008	170,901
Yugoslavia	3,300	14,988	1,650	8,250	12,272	62,798	16,891	95,499		
	547,026	2,390,122	786,695	3,249,225	895,881	4,335,632	974,326	4,954,489	1,045,005	5,620,333

Exports of high-grade, hard-rock phosphate from the different customs districts are shown in the following table. In 1936 most of this type of rock was exported from the Florida district, but a large quantity of high-grade, hard-rock phosphate was shipped from the Montana-Idaho district to Canada.

High-grade hard-rock phosphate exported from the United States, 1935–36, by customs districts

Customs district	1935		1936	
	Long tons	Value	Long tons	Value
Buffalo	1,448	$16,031	1,948	$20,391
Florida	101,155	697,260	124,675	881,650
Michigan			(1)	9
Montana-Idaho	27,459	105,655	37,323	222,079
New York	6	71		
	130,068	819,017	163,946	1,124,129

[1] Less than 1 ton.

WORLD PRODUCTION

Data available at present indicate that the United States was the leading producer of phosphate rock in 1936, with Tunisia second and Morocco third. Production in the United States increased in 1936 over 1935, while that in Tunisia, Algeria, and Morocco declined slightly. The U. S. S. R. (Russia) is an important producer of phosphate rock, due largely to the development of its Kola Peninsula apatite deposits, although in 1935 it is reported to have produced 1,750,300 tons of low-grade phosphate rock.

Statistical details of world production, trade, and consumption of phosphate rock for 1932, 1933, and 1934 were published during 1936.[10]

World production of phosphate rock, 1932–36, by countries, in metric tons

[Compiled by M. T. Latus]

Country	1932			1935	1936
Algeria	569,279	587,753	532,210	603,863	530,998
Angaur Island [1]	65,609	66,492	72,148	70,468	(2)
Australia:					
New South Wales	229	71	210	239	(2)
South Australia	654	26			(2)
Belgium	25,810	25,130	14,385	173,360	(2)
Canada	1,194	2,008	73	169	476
China	[3] 8,000	[3] 8,000	[3] 8,000	[3] 8,000	(2)
Christmas Island (Straits Settlements) [4]	85,548	92,745	129,780	149,341	157,634
Egypt	349,780	440,632	437,933	473,896	(2)
Estonia	1,133	8,950	10,609	11,642	(2)
France	82,700	76,650	66,800	(2)	(2)
Germany (Prussia)	(2)	(2)	735	180	(2)
India, British	123	38	60	104	(2)
Indochina	373		4,600	5,893	(2)
Japan	18,707	34,739	56,500	91,248	(2)
Madagascar	7,100	13,100	8,340	6,000	(2)
Makatea Island [4]	120,650	79,045	77,470	130,353	(2)
Morocco, French [5]	987,317	1,107,333	1,266,796	1,303,182	1,257,796
Nauru and Ocean Islands [6]	438,466	670,898	565,522	707,051	(2)
Netherland India	2,724	7,946	5,013	11,553	(2)
Netherland West Indies: Curaçao [4]	65,407	85,550	100,627	90,709	78,131
New Caledonia	1,000	6,000	2,000	9,000	(2)
Philippine Islands	830	3,097	(2)	(2)	(2)
Poland	(2)	6,350	7,655	13,500	(2)
Rumania			1,219	(2)	(2)
Seychelles Islands [4]	14,213	12,307	12,062	10,082	(2)
Spain	9,980	14,507	19,297	(2)	(2)
Tanganyika Territory			208	194	(2)
Tunisia	1,678,000	1,810,000	1,766,000	1,500,500	1,496,700
Union of South Africa	1,183	1,181	77		(2)
U. S. S. R. (Russia) [7]	156,500	213,400	382,800	767,900	(2)
United States (sold or used by producers)	1,734,300	2,530,282	2,880,017	3,091,211	3,405,654

[1] Exports during fiscal year ended Mar. 31 of year following that stated.
[2] Data not available.
[3] Estimated (Imp. Inst., London).
[4] Exports.
[5] Shipments, including exports as follows: 1932, 972,692 tons; 1933, 1,091,174 tons; 1934, 1,255,847 tons; 1935, 1,296,052 tons; 1936, 1,247,923 tons.
[6] Exports during fiscal year ended June 30 of year stated.
[7] Apatite concentrates. Production of apatite ore in 1935 amounted to 1,555,300 tons; in addition 1,750,300 tons of low-grade phosphate rock were reported.

[10] Gray, A. N., Statistics of Phosphate and Superphosphate for 1934. I, Phosphate Rock: Superphosphate (London), vol. 9, no. 1, 1936, pp. 1–7.

IMPROVEMENTS IN TECHNOLOGY

The calcination of phosphate rock for the removal of the fluorine content and the conversion of the insoluble phosphate rock into citrate-soluble form readily available as plant food were described in two papers.[11]

An apparatus for the determination of fluorine in phosphate rock by the Willard and Winter method was described by Reynolds and associates.[12]

SUPERPHOSPHATES

Salient features of the superphosphate industry in the United States are shown in the following table covering the 4-year period, 1933–36, inclusive.

Summary of statistics for superphosphate industry in the United States, 1933–36

	1933	1934	1935	1936
Production:[1]				
Bulk superphosphate short tons	2,694,870	2,868,016	2,954,130	3,412,486
Base and mixed goods do	117,046	116,533	109,609	142,459
Shipments:[1]				
Bulk superphosphates, to consumers do	824,176	829,490	824,177	997,011
Bulk superphosphates, to others do	953,880	1,120,367	1,223,132	1,672,049
Base and mixed goods do	1,131,707	1,264,216	1,354,728	1,480,719
Stocks (Dec. 31):[1]				
Bulk superphosphates do	1,089,179	1,159,392	1,217,767	1,133,640
Base and mixed goods do	497,589	567,974	619,909	657,828
Exports of superphosphates[2] long tons	35,371	59,148	54,965	68,368
Imports of superphosphates[2] do	23,705	16,308	20,543	18,395
Sales of phosphate rock by producers for superphosphate production do	1,467,441	1,561,066	[3] 1,690,554	1,768,677

[1] Bureau of the Census, Monthly Statistics Superphosphate Industry; 16 percent available phosphoric acid.
[2] Bureau of Foreign and Domestic Commerce.
[3] Revised figures.

Several papers on the manufacture, composition, and properties of superphosphate appeared during 1936.[13]

[11] Reynolds, D. S., Marshall, H. L., Jacob, K. D., and Rader, L. F., Jr., Phosphate Fertilizers by Calcination Process. Experiments with Phosphate Rock in Very Thin Layers: Ind. and Eng. Chem., vol. 28, no. 6, 1936, pp. 678–682.
Jacob, K. D., Rader, L. F., Jr., and Tremearne, T. H., Factors Affecting the Determination of Available Phosphorus in Calcined Phosphate and Other Water-Insoluble Phosphates: Jour. Assoc. Official Agric. Chem., 1936, pp. 449–471.

[12] Reynolds, D. S., Kershaw, J. B., and Jacob, K. D., A Multiple-Unit Distilling Apparatus for determination of Fluorine by the Willard and Winter Method: Jour. Assoc. Official Agric. Chem., 1936, pp. 156–162.

[13] Copson, R. L., Newton, R. H., and Lindsay, J. D., Superphosphate Manufacture. Mixing Phosphate Rock with Concentrated Phosphoric Acid: Ind. and Eng. Chem. (Ind. Ed.), vol. 28, no. 8, 1936, pp. 923–927.
Hill, W. L., and Hendricks, S. B., Composition and Properties of Superphosphate. Calcium Phosphate and Calcium Sulphate Constituents as Shown by Chemical and X-ray Diffraction Analysis: Ind. and Eng. Chem., vol. 28, no. 4, 1928, pp. 440–447.
Hill, W. L., and Beeson, K. C., Composition and Properties of Superphosphate. IV, Free Acids in Fresh Superphosphate: Jour. Assoc. Official Agric. Chem., vol. 19, no. 2, 1936, pp. 328–338.
Curtis, H. A., Miller, A. M., and Junkins, J. N., T. V. A. Estimates Favorable Costs for Concentrated Superphosphate: I, Chem. and Met. Eng., vol. 43, no. 11, 1936, pp. 583–587; II, vol. 43, no. 12, 1936, pp. 647–650.
Newton, R. H., and Copson, R. L., Superphosphate Manufacture: Composition of Superphosphate Made from Phosphate Rock and Concentrated Phosphoric Acid: Ind. and Eng. Chem. (Ind. Ed.), vol. 28, no. 10, 1936, pp. 1182–1186.

Superphosphates imported into the United States, 1934–36, by countries

Country	1934 Long tons	1934 Value	1935 Long tons	1935 Value	1936 Long tons	1936 Value
Belgium	140	$4, 594	1, 392	$32, 115	1, 348	$36, 070
Canada	6, 119	98, 420	10, 048	161, 651	8, 832	161, 485
France					99	5, 600
Germany	43	341	97	873	752	9, 048
Japan	9, 362	131, 637	8, 316	137, 427	6, 938	125, 578
Netherlands	644	10, 548	690	8, 659	426	5, 025
	16, 308	245, 540	20, 543	340, 725	18, 395	342, 806

Superphosphates (acid phosphates) exported from the United States, 1934–36, by countries

Country	1934 Long tons	1934 Value	1935 Long tons	1935 Value	1936 Long tons	1936 Value
British Malaya	26	$600			1	$44
Canada	42, 747	433, 346	38, 869	$378, 631	55, 429	550, 835
China	2	90				
Colombia	11	528	3	58	14	624
Costa Rica	5	105	2	28		
Cuba	13, 606	136, 950	15, 916	150, 765	9, 399	98, 890
Dominican Republic			66	2, 694	56	2, 564
Honduras	6	106	27	474		
Mexico	28	963	3	53	18	567
Philippine Islands	500	14, 660				
United Kingdom	2, 213	18, 333			2, 945	27, 039
Venezuela	4	90	1	20		
Other	(1)	21	78	1, 160	506	7, 023
	59, 148	605, 792	54, 965	533, 883	68, 368	687, 586

[1] Less than 1 ton.

Since January 1, 1935, monthly imports of superphosphate have been subdivided into three classes: (1) Superphosphates standard (not over 20 percent P_2O_5 content), (2) superphosphates treble (over 20 percent P_2O_5 content), and (3) superphosphates ammoniated.

Statistics for 1934, covering international trade in superphosphate and production and consumption of superphosphate in various countries, were published early in 1936.[14]

BASIC SLAG

Basic slag, a byproduct of the manufacture of basic steel, contains considerable phosphorus in a form readily available as plant food, and it has been used as phosphorus-bearing fertilizer since the early eighties, following the invention of the Thomas and Gilchrist modification of the Bessemer process of steel making in 1878. In Germany, Belgium, England, Luxemburg, and France, where highly phosphatic iron ores are used in the manufacture of steel and where large quantities of basic slag are available, it has developed into an important source of phosphorus, competing directly with phosphate rock and superphosphates. The production of basic slag in recent years is shown in the following table. European consumption of basic

[14] Gray, A. N., Statistics of Phosphates and Superphosphate for 1934, II, Superphosphate: Superphosphate, vol. 9, no. 2, 1936, pp. 21–35.

slag (known as Thomas slag) in 1928 exceeded 4 million tons, about 58 percent of which was used in Germany.

European production of basic phosphate slag, 1931–34, in metric tons

[Source: Internat. Inst. Agric., Rome] [1]

Country	1931	1932	1933	1934
Belgium	593,000	577,000	610,000	635,000
Czechoslovakia	112,198	66,288	71,383	93,874
France	1,294,000	782,000	988,500	878,900
Germany:				
Saar	257,534	237,710	266,820	322,681
Other	900,000	533,000	830,000	1,400,000
Great Britain	167,648	162,568	194,065	266,509
Latvia	124	1,471	6,319	1,007
Luxemburg	430,683	401,106	392,961	409,210
Sweden	10,171	7,730	8,911	12,822
	3,765,358	2,768,873	3,368,959	4,020,003

[1] Bureau of Foreign and Domestic Commerce, World Trade Notes: Vol. 10, no. 36, 1936, p. 4.

Although the production and consumption of basic slag is confined principally to European countries, some is produced in the United States, principally from the Birmingham district of Alabama,[15] where about 35,000 tons are produced annually by the Tennessee Coal, Iron & Railroad Co., a subsidiary of the United States Steel Corporation. Here it is a byproduct of the basic open-hearth process of making steel from the red-hematite iron ores of the Birmingham district. The slag formed in the furnaces in this operation is poured off, cooled, crushed, and ground to a fine powder (90 percent of which will pass through a 100-mesh screen) which is sold as a soil conditioner with a guaranteed minimum of 8 percent phosphoric acid.

A small quantity of basic slag (from 131 to 3,998 long tons annually) has been imported into the United States in recent years.

[15] Cudworth, J. R., and Mead, J. C., Utilization of Slag in the Birmingham District, Ala.: Am. Inst. Min. and Met. Eng., Tech. Pub. 796, 1937, 9 pp.

Bowron, R. L., Basic Open-Hearth Slag an Important Byproduct at the Ensley Works: Min. and Met. vol. 18, no. 364, April 1937, pp. 198–199.

TALC AND GROUND SOAPSTONE[1]

By Carl A. Gnam and M. A. Cornthwaite

SUMMARY OUTLINE

In general, conditions in the talc and ground-soapstone industry during 1936 were better than in any year since 1929. Ground soapstone is included with talc in this chapter because soapstone is essentially an impure talc and when pulverized is used for the same purposes and competes directly with ground talc. North Carolina pyrophyllite also is included, following the precedent established many years ago by the United States Geological Survey in its annual reviews of the talc industry. Although pyrophyllite resembles talc in certain physical properties and uses, it is an aluminum silicate resembling clay in chemical composition and is classed by several mineralogists as a subvariety of kaolinite.

Sales.—Sales of 216,191 short tons of talc and soapstone valued at $2,343,171 exceeded corresponding figures for 1935 by 25 and 27 percent, respectively. The increases resulted principally from a greater output of ground material which represented about 95 percent of the total production. A slightly higher tonnage of crude material was offset by a decline in the quantity of sawed and manufactured products, although the value of the latter increased nearly 50 percent.

Talc and ground soapstone sold by producers in the United States, 1932–36, by classes

Year	Crude		Sawed and manufactured		Ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1932 [1]	5,635	$51,657	107	$17,749	117,479	$1,292,227	123,221	$1,361,633
1933	5,985	46,553	246	31,686	159,792	1,653,643	166,023	1,731,882
1934	8,767	55,659	174	46,918	129,564	1,346,108	138,505	1,448,685
1935	10,725	57,259	841	63,211	161,150	1,727,585	172,716	1,848,055
1936	10,910	59,556	618	90,542	204,663	2,193,073	216,191	2,343,171

[1] Includes talc only.

Production by States.—The output of talc and ground soapstone in 1936 was obtained from 35 mines in 9 States, compared with 33 mines in 11 States in 1935. Talc was produced in California, Georgia, Maryland, New York, North Carolina, Vermont, and Washington; soapstone in California, Pennsylvania, Virginia, and Washington; and pyrophyllite in North Carolina.

[1] Soapstone sold in slabs or blocks is included under "Dimension stone" in the chapter on Stone.

Talc and ground soapstone sold by producers in the United States, 1935–36, by States

State	1935		1936	
	Short tons	Value	Short tons	Value
Arkansas	17	$82		
California	21,464	290,439	28,199	$403,392
Georgia	(1)	(1)	11,473	114,545
New York	69,125	[2] 817,092	85,429	1,043,232
North Carolina	20,913	220,074	27,877	280,026
Vermont	42,739	381,643	45,746	410,045
Washington	633	2,550	462	1,805
Undistributed [3]	17,825	136,175	17,005	90,126
	172,716	1,848,055	216,191	2,343,171

[1] Included in "Undistributed."
[2] Partly estimated.
[3] 1935: Georgia, Maryland, New Jersey, Pennsylvania, and Virginia; 1936: Maryland, Pennsylvania, and Virginia.

Producers of talc and soapstone in the United States in 1936

Producer	Material	Product	Location of mine
CALIFORNIA			
Blue Star Mines, Ltd., 840 San Julian St., Los Angeles.	Talc	Ground	Near Bigpine, Inyo County.
Chamberlain Co., Los Angeles	do	Crude	
W. R. Fawcett, 634 S. Spring St., Los Angeles.	do	Ground	Keeler, Inyo County.
Industrial Minerals & Chemicals Co., 6th and Gilman Sts., Berkeley.	Soapstone	do	Berkeley, Alameda County
Frank McDonald, Shingle	do	Crude	1¼ miles from Shingle.
W. S. McLean, 419 Bay Shore Blvd., San Francisco.	do	do	Butte County.
Pacific Coast Talc Co., 2149 Bay St., Los Angeles.	Talc	Rough, ground	7 miles north of Silver Lake Station, San Bernardino County.
Pacific Minerals Co., Ltd., 337 10th St., Richmond.	Soapstone	Ground	Shrub, Eldorado County.
Sierra Talc Co., 428 Union League Bldg., Los Angeles.	Talc	do	Near Darwin, Inyo County.
Thomas & Skeoch, Tecopa	do	Crude	Tecopa, Inyo County.
Victorville Limerock Co., 2424 Enterprise St., Los Angeles.	Soapstone	do	Saugus, Los Angeles County.
Western Talc Co., 1901 E. Slauson Ave., Los Angeles.	Talc	Rough, ground	Tecopa, San Bernardino County.
GEORGIA			
Cohutta Talc Co., Dalton	do	Crayons, ground	Chatsworth, Murray County
Georgia Talc Co., Asheville, N. C.	do	do	Do.
Southern Talc Co., Chatsworth	do	Crude, ground	Do.
MARYLAND			
Harford Talc & Quartz Co., P. O. Box 63, Towson.	Talc, massive steatite, or "lava" grade.	Rough, ground	Near Dublin, Harford County.
Seaboard Operating Co., Baltimore.	Talc	do	Sykesville, Carroll County.
NEW YORK			
Carbola Chemical Co., Inc., Natural Bridge.	do	Ground	1¼ miles from Natural Bridge, Lewis County.
International Pulp Co., 41 Park Row, New York.	do	do	Talcville, St. Lawrence County.
W. H. Loomis Talc Corporation, 223 E. Main St., Gouverneur.	do	do	Gouverneur, Lawrence County.
NORTH CAROLINA			
Carolina Pyrophyllite Co., 10 E. 40th St., New York, N. Y.	Pyrophyllite	Crude	Staley, Randolph County.
Carolina Talc Co., Murphy	Talc	Crayons, ground	Near Murphy, Cherokee County.
Clinchfield Sand & Feldspar Co., Murphy.	do	do	Do.
Nantahala Co., Andrews	do	Crude	Hewitt, Swain County.

Producers of talc and soapstone in the United States in 1936—Continued

Producer	Material	Product	Location of mine
NORTH CAROLINA—continued			
Standard Mineral Co., Inc., 230 Park Ave., New York, N. Y.	Pyrophyllite	Ground	2½ miles from Hemp, Moore County.
Talc Mining & Milling Corporation, 150 Whiton St., Jersey City, N. J.	Talc	do	Glendon, Moore County.
Tennessee Mineral Products Corporation, Spruce Pine.	Pyrophyllite	do	Staley, Randolph County.
PENNSYLVANIA			
C. K. Williams & Co., 640 N. 13th St., Easton.	Soapstone	Crude	Near Easton, Northampton County.
VERMONT			
Eastern Magnesia Talc Co., Inc., 117 Liberty St., New York, N. Y.	Talc	Crayons, ground	Johnson, Lamoille County, and Waterbury, Washington County.
Vermont Mineral Products, Inc., Chester.	do	Ground	Near Chester, Windsor County.
Vermont Talc Co., Chester	do	do	Windham, Windham County.
VIRGINIA			
Blue Ridge Talc Co., Inc., Henry	Soapstone	Rough, ground	Near Henry Station, Franklin County.
Alberene Stone Corporation, Schuyler.	do	Dimension stone, furnace blocks, special products, ground.	Schuyler, Nelson County.
WASHINGTON			
Asbestos-Talc Products of Washington, Inc., Burlington.	Talc	Ground	Burlington, Skagit County.
H. P. Scheel, Jr., Rockport	do	Rough	Near Marblemount, Skagit County.
Skagit Talc, Inc., 300 Shubert Bldg., St. Paul, Minn.	Soapstone	Crude, furnace blocks.	Near Rockport, Skagit County.

MARKETS

The trend in sales of talc and soapstone has always followed rather closely the general business cycle; the principal exception in the last few years was the unusual rise in 1933 followed by a rather sharp decline in 1934. (See fig. 107.) However, the welfare of the talc and soapstone industry depends more specifically on the demands of the paint, paper, roofing, and rubber industries, and changes in consumption within that group are of particular significance to the producers. Declines in consumption of talc in some industries have been compensated by greater use of talc in others, so that total production reached a relatively high level in 1936. Data available for 1931 and 1936 showing percentages of the output purchased by various industries indicate the changes that have taken place within that 5-year period. The most evident decline was in sales to paint manufacturers—from 48 percent of the total in 1931 to 29 percent in 1936. This situation occurred despite appreciable increases in sales of paint since 1932 and suggests the possibility of a permanent loss in that market. The decline from that source, however, was overcome partly by greater sales to manufacturers of rubber products and roofing and to a considerable extent by the use of talc in ceramics. The increased demand from the rubber industry indicates not only a greater consumption of rubber products but also a displacement of

mica, with which talc competes for use in dusting molds. The advance in sales to the ceramic industry is particularly important because it has been due mainly to the greater use of talc as a constituent of wall tile, the production of which has been increasing with the sharp rise in building construction.

Percentages of ground talc and soapstone sold to consuming industries in the United States, 1931 and 1936 [1]

Industry	1931	1936	Industry	1931	1936
Paint	48	29	Toilet preparations	3	1
Paper	16	17	Foundry facings	1	1
Roofing	11	13	Other	9	14
Rubber	11	15			
Ceramics	1	10		100	100

[1] Includes 96 percent of sales in 1931 and 90 percent in 1936.

Demands for talc for paper manufacture appear to have remained rather constant; 16 percent of the total output of the ground product in 1931 and 17 percent in 1936 were sold to this industry. A comparison of the production of talc with that of fine paper shows a remarkable similarity in trends during the last 5 years, especially in 1933 and 1934, when there was an unusual rise and decline in both industries. It is

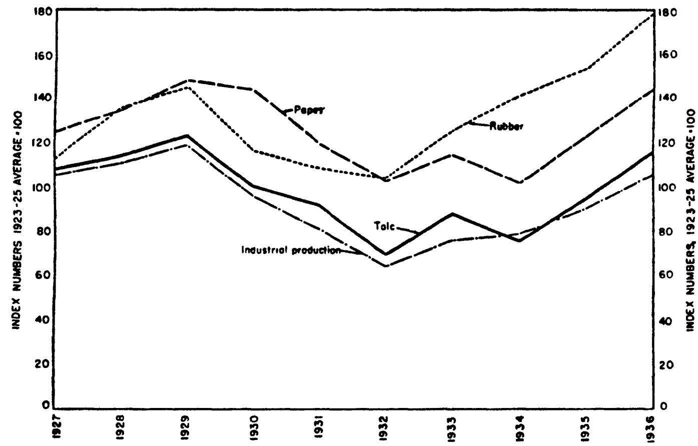


FIGURE 107.—Trends in production of talc and ground soapstone, sales of fine paper, consumption of rubber, and industrial production, 1927-36. Indexes for paper and rubber computed from data of Bureau of Foreign and Domestic Commerce; industrial production index is from the Federal Reserve Board.

difficult to explain the relationship in view of the rather small percentage of talc sold to the paper industry, nevertheless the similarity suggests a means of estimating the annual talc production in advance of official statistics. Data for fine-paper production appear monthly in the Survey of Current Business, published by the United States Department of Commerce.

Sales of high-grade talc for the manufacture of toilet preparations were smaller than usual in 1936, comprising only 1 percent of the total production. The demand from manufacturers of foundry facing remained about the same as in the past few years.

Other markets for ground talc and soapstone in 1936 included many industries, none of which purchased a large quantity but which in the

aggregate consumed 14 percent of the entire output. Some of the miscellaneous uses reported by producers were as a cloth filler; for cotton bleaching; as a polish for rice, peanuts, and glass; and as an ingredient of lubricants, concrete, plaster, and insecticides.

PRICES

The price of talc and ground soapstone in 1936, as represented by the average value per ton of all grades of material, was $10.84—14 cents a ton more than in 1935 and the highest since 1932. The slight increase was due principally to the higher value of sawed and manufactured material, which was $146.51 per ton in 1936 and $75.16 in 1935. The average value per ton of ground talc and soapstone was virtually the same in both years, and the value of crude increased only 12 cents a ton.

Average values per ton of talc and ground soapstone in each year from 1927 to 1936, inclusive, are shown in the following table.

Average value per ton of talc and ground soapstone sold by producers, 1927–36

	Value per ton		Value per ton
1927	$11.62	1932	$11.05
1928	12.50	1933	10.43
1929	11.96	1934	10.44
1930	11.75	1935	10.70
1931	11.31	1936	10.84

DEVELOPMENTS IN THE INDUSTRY

A cooperative investigation by the Bureau of Mines, the Missouri School of Mines and Metallurgy, and the Eastern Magnesia Talc Co. determined that talc concentrates and magnesite tailings could be obtained through beneficiation of Vermont talc-magnesite ores by flotation.

Up to now technical developments in the talc industry have been confined largely to improvements in the mechanical preparation of various products. Little or no attempt has been made to beneficiate talc rock by recognized ore-dressing methods. Selective mining when necessary, followed by crushing and grinding dry to 200-mesh or finer by pebble mills or other crushing devices in closed circuit with air separators, has been the customary method of preparation. In certain instances a moderate degree of beneficiation has been obtained by rejecting the separator tailings. Although the talc recovery was low the procedure was justified because it enabled the operator to meet the demands of the trade for specific grades. The disposal of the separator tailings containing 30 to 40 percent of talc became increasingly serious as the demand for the higher grades increased. In some instances as much as 3 tons of talc rock were required to produce 1 ton of the desired grade. The 2 tons accruing as a low-grade product had relatively little value and were difficult to market.

Flotation promises a means for eliminating undesirable impurities from the rejected material and low-grade talcs and at the same time may yield a product with better texture and "feel" from higher-grade talcs.

The United Feldspar Corporation, through its subsidiary, the Tennessee Mineral Products Corporation, acquired the entire capital

stock of the Carolina Pyrophyllite Co., Staley, N. C. Plans have been made to erect a mill at or near the mines to grind the raw material.[2]

The talc-schist property, formerly operated by Herbert I. Oursler, Mariottsville, Md., is now operated by the Seaboard Operating Co., 430 Hearst Tower Building, Baltimore, Md., a subsidiary of the Clinchfield Sand & Feldspar Corporation. The old mill has been reconditioned.

FOREIGN TRADE

Imports.—Imports of talc and soapstone, classified as talc, steatite, or soapstone and French chalk, crude, manufactured, or ground, amounted to 24,519 short tons valued at $456,667 in 1936. Compared with imports in 1935 the quantity was 3 percent greater and the value 7 percent less. The increase in quantity resulted from the larger amounts furnished by China, Canada, and Norway and the decline in value from the smaller amounts of high-priced materials purchased from Italy and France. Canada continued to be the largest source of supply, and Italy and France were next in importance.

Talc imported for consumption in the United States, 1932–36

Year	Crude and unground steatite and French chalk		Manufactures (except toilet preparations) wholly or partly finished		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1932	162	$4,099	19,926	$355,836	20,088	$359,935
1933	248	2,628	21,899	388,888	22,147	391,516
1934	204	4,729	20,245	421,640	20,449	426,369
1935	298	5,856	23,598	486,418	23,896	492,274
1936	188	2,915	24,331	453,752	24,519	456,667

Talc, steatite, or soapstone, and French chalk, crude, manufactured, or ground, imported into the United States, 1935–36, by countries

Country	1935		1936	
	Short tons	Value	Short tons	Value
Austria	12	$138	1	$69
Belgium			28	195
Canada	8,030	81,292	8,450	85,541
China	492	32,564	1,426	41,346
Czechoslovakia			33	1,203
Egypt	11	340	1	26
France	5,514	111,954	5,150	86,695
Germany	(1)	3	11	69
Hong Kong	(1)	31	(1)	85
India (British)	34	646	107	1,647
Italy	7,323	236,187	7,197	212,480
Japan	1,709	23,115	1,474	20,334
Kwantung	145	1,433	100	1,137
Malaya (British)			(1)	8
Norway	166	1,442	395	3,585
Spain			1	36
Union of South Africa			6	308
U. S. S. R. (Russia)	437	2,472		
United Kingdom	23	657	139	1,903
	23,896	492,274	24,519	456,667

[1] Less than 1 ton.

[2] Glass Industry, vol. 17, no. 11, p.

Exports.—Exports of talc and soapstone continued to increase in 1936. Crude talc has been classified separately since 1932, and the 1936 exports of 6,669 short tons valued at $115,434 exceeded those of the preceding 3 years. The total value of talc exports, including talcum, face, and compact powders, was $803,571, which was higher than in any year since 1931.

Exports of talcum and other powders from the United States, 1932–36

Year	Description	Short tons	Value
1932	Powders—talcum, face, and compact	(1)	$646,605
1933	Talc, crude, in bulk	3,956	68,389
	Powders—talcum (in packages), face, and compact	(1)	618,026
1934	Talc, crude, in bulk	4,903	83,530
	Powders—talcum (in packages), face, and compact	(1)	598,404
1935	Talc, crude, in bulk	5,814	101,290
	Powders—talcum (in packages), face, and compact	(1)	711,383
1936	Talc, steatite, and soapstone, crude and ground	6,669	115,434
	Powders—talcum (in packages), face, and compact	(1)	803,571

[1] Quantity not recorded

WORLD PRODUCTION

Talc occurs rather widely throughout the world, and available information indicates that the mineral is produced in at least 24 countries. Data for 1936 are limited, but undoubtedly the United States continued to lead all other countries in quantity produced. The next largest producing countries, in the order of their importance, are usually France, China (including Manchuria), and Italy.

World production of talc and soapstone, 1932–36, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1932		1934		1936
Australia:					
New South Wales		398		511	(2)
South Australia		1,399		954	(2)
Tasmania		9			3
Austria (exports)		20,871		20,786	19,891
Bulgaria				15	(2)
Canada [3]	10,980	13,772		12,522	20,501
China (including Manchuria)	45,996	65,430		(2)	(2)
Egypt	232	2,531		366	(2)
Finland	1,625	1,288		2,185	(2)
France	68,500	77,450		(2)	(2)
Germany (Bavaria)	3,197	5,107		3,963	(2)
Greece	617	1,272		(2)	(2)
India, British	6,617	17,322		12,798	(2)
Italy	32,404	34,487		43,200	(2)
Morocco, French (exports)	837	526		720	(2)
Norway	13,536	19,885		(2)	(2)
Rumania	1,798	1,112		1,978	(2)
Spain	6,574	10,064		(2)	(2)
Sweden	4,525	4,396		6,063	(2)
Union of South Africa (Transvaal)	269	280		303	411
United Kingdom	262	169			(2)
United States	[4] 111,784	[5] 148,840	,948	[5] 166,594	[5] 191,464
Uruguay (exports)	2,625	1,270	879	1,200	772

[1] In addition to the countries listed talc is produced in Argentina, Brazil, and the U. S. S. R. (Russia), but data of production are not available.
[2] Data not available.
[3] Excluding soapstone, which is reported only by value and was as follows: 1932, $46,751; 1933, $43,593; 1934, $44,297; 1935, $32,053; 1936, $32,770. Soapstone is sold in the form of both blocks and powder.
[4] Figures represent sales of talc only. Bureau of Mines not at liberty to publish figures for soapstone.
[5] Figures represent total mine production of talc and ground soapstone from 1933 to 1935, quantity sold or used by producers in 1936.

FLUORSPAR AND CRYOLITE

By H. W. Davis

Summary Outline

FLUORSPAR

Increased demand for fluorspar, chiefly by manufacturers of basic open-hearth steel and hydrofluoric acid, the two largest consumers, was reflected by the consumption of 182,400 short tons of fluorspar in 1936 compared with 137,400 tons (revised figure) in 1935. This improved demand resulted in the reopening of many inactive mines, the development of several new mines and prospects, and the resumption of operations by the Aluminum Ore Co. at the flotation mill at Rosiclare, Ill., and the concentrating mill at Marion, Ky. In consequence, mine production and shipments of fluorspar in 1936, as well as imports, were substantially higher than in 1935. In fact, so great was the demand for fluorspar in 1936 that shipments from domestic mines have been exceeded in only 3 years—1917, 1918, and 1920.

Total sales of fluorspar to consumers in the United States in 1936 were 201,148 short tons (176,231 tons from domestic mines and 24,917 tons imported) compared with 140,047 tons (revised figure) in 1935 (123,741 tons (revised figure) from domestic mines and 16,306 tons imported). Total sales to the steel industry increased from 106,870 tons (revised figure) in 1935 to 156,714 in 1936, whereas sales to manufacturers of hydrofluoric acid advanced from 11,048 tons in 1935 to 21,510 in 1936. In fact, sales of acid-grade fluorspar in 1936 were the largest ever recorded, and shipments from domestic mines have been exceeded in only 2 years, 1928 and 1929. Although nonferrous smelters usually provide a comparatively small market for fluorspar, the gain in shipments from 868 tons in 1935 to 1,931 tons in 1936 was noteworthy. Sales to the enamel trade also increased, but those to the glass industry were slightly less than in 1935.

Salient statistics of the fluorspar industry in the United States, 1935-36

	1935		1936	
	Short tons	Value	Short tons	Value
Domestic shipments:				
Gravel	[1] 105,460	[1] $1,455,037	147,905	$2,421,128
Lump	5,268	101,578	11,967	289,666
Ground	13,013	304,023	16,359	400,474
	[1] 123,741	[1] 1,860,638	176,231	3,111,268
Stocks at mines or shipping points:				
Ready-to-ship	[1] 40,043	(2)	29,958	(2)
Crude	[1] 24,185	(2)	24,023	(2)
	[1] 64,228	(2)	53,981	(2)
Imports for consumption:				
Containing more than 97 percent CaF_2	10,578	149,823	10,028	139,959
Containing not more than 97 percent CaF_2	5,762	29,226	15,476	119,303
	16,340	179,049	25,504	259,262
Exports	313	4,651	240	4,079
Consumption (by industries):				
Metallurgical	108,400	(2)	144,900	(2)
Ceramic	[1] 16,100	(2)	17,400	(2)
Chemical	12,900	(2)	20,100	(2)
	[1] 137,400	(2)	182,400	(2)
Stocks at consumers' plants Dec. 31:				
Metallurgical	49,600	(2)	62,000	(2)
Ceramic	2,800	(2)	3,700	(2)
Chemical	5,600	(2)	6,900	(2)
	58,000	(2)	72,600	(2)

[1] Revised figures.
[2] Figures not available.

The improved demand for fluorspar in 1936 was accompanied by a substantial increase in the average selling price of fluxing-gravel fluorspar, from $13.76 a ton f. o. b. Illinois-Kentucky mines in 1935 to $16.53 a ton in 1936. The average selling price of all grades increased from $15.04 a short ton in 1935 to $17.65 in 1936. The average selling price of imported fluxing-gravel fluorspar increased from $18 a short ton in 1935 to $19.04 in 1936.

Other important developments in 1936 were increases of 42 and 193 percent in the consumption of acid-grade fluorspar as a refrigerating medium and in the manufacture of aluminum, respectively; record shipments (46,895 tons) by barge for delivery at upper Ohio River landings; resumption of imports from France; shipments of 4,180 tons from Newfoundland to the United States; reduction in producers' stocks of gravel fluorspar; and increased shipments from the Chaffee County (Colo.) field, of which a considerable part moved to eastern markets.

Available data on trends in production, imports, consumption, and average value of fluorspar over a series of years are shown in figure 108.

Production and shipments.—Fluorspar was known to have been produced in 1936 at 100 mines and prospects, and small quantities were recovered at an undetermined number of other prospects and reclaimed from mill ponds, waste dumps, and old workings of abandoned mines. All operations yielded about 168,000 short tons of merchantable fluorspar compared with about 102,000 tons in 1935. In spite of

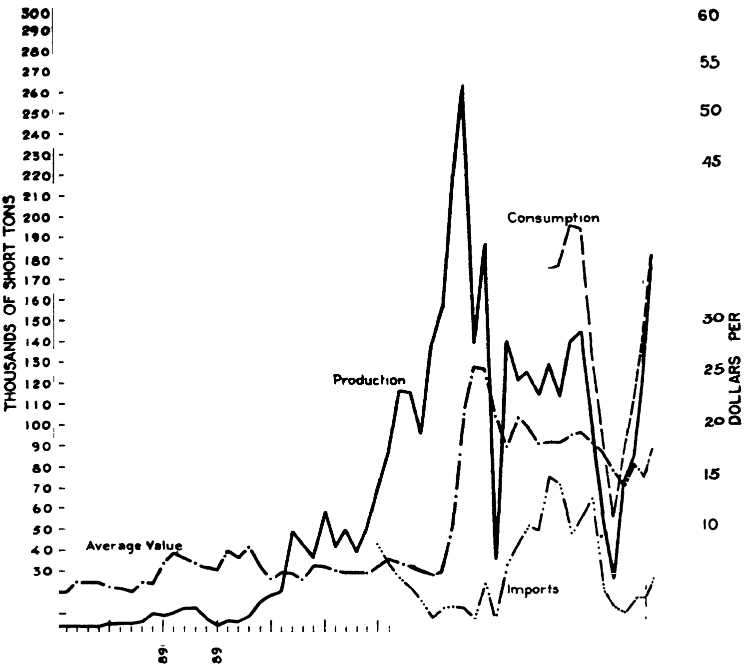


FIGURE 108.—Trends in production and average value per ton of fluorspar in the United States, 1880–1936; in imports, 1910–36; and in consumption, 1926–36.

the large number of properties worked in 1936, however, 27 mines produced 87 percent of the total output.

Shipments of fluorspar from domestic mines in 1936 aggregated 176,231 short tons valued at $3,111,268, increases of 42 percent in quantity and 67 percent in total value over 1935. Shipments in 1936 were equivalent to 141 percent of the average annual tonnage shipped in the 5-year period 1926–30. Of the 1936 shipments, 46,895 tons were shipped by barge for delivery at upper Ohio River landings compared with 23,800 tons in 1935.

The average value of all grades was $17.65 a ton in 1936, or $2.61 more than the 1935 average. The value recorded for domestic fluorspar is the price paid f. o. b. mine shipping point by the consumer and excludes cost of containers. The average value per ton of the fluorspar shipped to steel plants from the Illinois-Kentucky district was $16.53 in 1936 compared with $13.76 in 1935 and from the Chaffee County (Colo.) field $8.16 in 1936.

The following table presents such details of shipments of fluorspar by States from 1934 to 1936 as may be published without revealing, except by permission, operations of individual producers.

Fluorspar shipped from mines in the United States, 1934–36, by States

State	Gravel [1]			Lump			Ground [2]			Total		
	Short tons	Value		Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average		Total	Average		Total	Average		Total	Average
1934												
Colorado	6,537	$83,132	$12.72							6,537	$83,132	$12.72
Illinois	28,922	457,050	15.80	572	$60,135	$19.39	3,740			33,234	567,396	17.07
Kentucky	37,942	570,538	15.04	2,529			2,692	$209,296	$24.81	43,163	690,990	16.01
Nevada	627						4			631		
New Mexico	40	11,254	13.27				2,000			2,040	49,887	17.49
California	181									181		
	74,249	1,121,974	15.11	3,101	60,135	19.39	8,436	209,296	24.81	85,786	1,391,405	16.22
1935												
Illinois	36,766	505,370	13.75	1,013	99,009	20.16	6,311			44,120	685,794	15.54
Kentucky	60,799	847,660	13.94	3,897			3,983	304,023	23.36	68,679	1,017,451	14.81
New Mexico	51						2,675			2,726		
Nevada	974			52			14			1,040		
Colorado	6,678	[3] 102,007	12.92	300	2,453	6.97				6,978	[3] 157,277	[3] 14.38
New Hampshire	12									12		
Utah	[3] 180									[3] 180		
Tennessee				6	116	19.33				6	116	19.33
	[3] 105,460	[3] 1,455,037	13.80	5,268	101,578	19.28	13,013	304,023	23.36	[3] 123,741	[3] 1,860,638	15.04
1936												
Illinois	69,247	1,196,695	17.28	3,546	284,473	24.93	9,263			82,056	1,525,606	18.59
Kentucky	67,036	1,083,959	16.17	7,865			5,340	400,474	24.48	80,241	1,409,433	17.56
New Mexico	297	30,296	12.54				1,748			2,045	60,858	14.59
Nevada	2,118						8			2,126		
Colorado	8,887			525	5,193	9.31				9,412		
New Hampshire	226	110,178	11.97	31						257	115,371	11.82
Arizona	40									40		
Utah	54									54		
	147,905	2,421,128	16.37	11,967	289,666	24.21	16,359	400,474	24.48	176,231	3,111,268	17.65

[1] Includes flotation concentrates shipped for use in making hydrofluoric acid and cement and run-of-mine fluorspar for use as flux in steel plants.
[2] Includes flotation concentrates shipped to the glass and enamel trades.
[3] Revised figures.

Shipments, by uses.—The following table shows the relative importance of consuming industries as markets for fluorspar; the predominance of the steel industry as a purchaser of fluorspar is evident.

Fluorspar shipped from mines in the United States, 1935–36, by uses

Use	1935				1936			
	Percent	Short tons	Value		Percent	Short tons	Value	
			Total	Average			Total	Average
Steel	[1] 81.76	[1] 101,168	[1] $1,392,661	$13.77	80.36	141,618	$2,296,792	$16.22
Foundry	1.89	2,336	29,068	12.44	1.32	2,326	36,729	15.79
Glass	[1] 8.29	10,256	227,917	22.22	6.25	11,014	267,290	24.27
Enamel and vitrolite	[1] 3.30	4,087	100,686	24.64	2.98	5,249	129,206	24.62
Hydrofluoric acid and derivatives	[1] 2.69	3,333	74,732	22.42	7.16	12,627	326,048	25.82
Miscellaneous	1.82	2,248	30,923	13.76	1.79	3,157	51,124	16.19
	99.75	[1] 123,428	[1] 1,855,987	15.04	99.86	175,991	3,107,189	17.66
Exported	.25	313	4,651	14.86	.14	240	4,079	17.00
	100.00	[1] 123,741	[1] 1,860,638	15.04	100.00	176,231	3,111,268	17.65

[1] Revised figures.

Consumption and consumers' stocks.—The following table gives data on consumption of fluorspar in 1935 and 1936 and stocks at consumers' plants at the close of each year.

Fluorspar consumed and in stock in the United States, 1935–36, by industries, in short tons

[Partly estimated by Bureau of Mines]

Industry	1935		1936	
	Consumption	Stocks at consumers' plants Dec. 31	Consumption	Stocks at consumers' plants Dec. 31
Basic open-hearth steel	99,600	47,500	133,900	59,200
Electric furnace steel	5,400	900	6,900	1,200
Foundry	1,900	800	1,900	700
Ferro-alloys	700	300	800	200
Hydrofluoric acid and derivatives	12,900	5,600	20,100	6,900
Enamel and vitrolite	4,900	900	5,400	1,200
Glass	[1] 11,000	1,700	11,600	2,300
Miscellaneous	1,000	300	1,800	900
	[1] 137,400	58,000	182,400	72,600

[1] Revised figures.

The following table shows the relation of consumption of fluorspar to production of basic open-hearth steel, 1932–36, and stocks of fluorspar at such steel plants at the close of each year.

Consumption and stocks of fluorspar at basic open-hearth steel plants, 1932–36

	1932	1933	1934	1935	1936
Production of basic open-hearth steel ingots and castings ... long tons	11,742,682	20,057,146	23,440,000	30,447,000	43,615,000
Consumption of fluorspar in basic open-hearth steel production ... short tons	36,300	61,300	81,000	99,600	133,900
Consumption of fluorspar per ton of steel made ... pounds	6.2	6.1	6.9	6.5	6.1
Stocks of fluorspar on hand at steel plants at end of year ... short tons	55,000	56,000	45,500	47,500	59,200

The quantity of fluorspar used by individual plants per ton of basic open-hearth steel produced ranges from 1 to 50 pounds—a relatively small proportion of the furnace charge. The average is generally 5 to 8 pounds; it decreased from 6.5 pounds in 1935 to 6.1 in 1936. The following table shows the variation in average consumption of fluorspar per ton of basic open-hearth steel over a 5-year period in certain plants that make about 88 percent of the total.

Average consumption of fluorspar per ton of steel, 1932–36, in pounds

1932	1933	1934	1935	1936	1932	1933	1934	1935	1936
14.176	18.944	14.443	13.243	13.187	5.302	5.659	7.488	7.048	6.734
4.572	3.864	4.766	4.182	4.792	6.646	6.754	6.584	9.347	10.495
5.122	4.687	5.141	4.803	4.541	6.056	8.148	9.820	8.168	5.104
6.136	5.731	9.958	8.452	10.519	6.356	5.386	5.900	5.236	5.027
6.281	6.871	6.195	7.027	4.105	6.118	6.590	6.429	6.764	6.357
5.171	5.858	5.768	5.658	5.160	6.260	6.099	6.780	5.257	5.917
6.842	4.289	5.046	6.857	7.416	5.366	6.601	7.348	7.088	6.671

Quoted prices.—The following table shows representative quoted prices in 1936 for fluxing-gravel and foundry-lump fluorspar at Illinois-Kentucky mines and fluxing-gravel fluorspar at seaboard. These prices are for carload or barge lots. Quotations for small lots usually are somewhat higher than those for large tonnages sold on contract.

Quoted prices per short ton of fluorspar in the United States in 1936

Month	Illinois-Kentucky (f. o. b. mines)			Imported (at seaboard, duty paid)[1]
	Fluxing gravel (not less than 85 percent CaF_2 and not over 5 percent SiO_2)		Foundry lump (not less than 85 percent CaF_2 and not over 5 percent SiO_2)	Fluxing gravel (not less than 85 percent CaF_2 and not over 5 percent SiO_2)
	Rail delivery	Barge delivery at Ohio River landings		
January	$16.00		$18.00	$20.00
February	17.50		19.50	20.00
March	17.50–18.00		19.50–20.00	20.00–21.50
April	18.00		20.00	21.50
May	17.00–18.00		20.00–19.00	21.50
June	17.50–16.50		19.50–18.50	21.50
July	17.00	$17.00	19.00	21.50
August	17.00	17.00	19.00	21.50
September	18.00	18.50	20.00	21.50
October	18.00	18.50	20.00	22.00
November	18.00	18.50	20.00	22.00
December	18.00	18.50	20.00	22.00–23.00

[1] Iron Age, vols. 137 and 138, 1936.

Stocks at mines or shipping points.—According to reports of producers the total quantity of fluorspar in stock at mines or shipping points at the close of 1936 was 53,981 short tons, a decrease of 16 percent from 1935. These stocks comprised about 24,000 tons of crude fluorspar (calculated to be equivalent to 12,700 tons of ready-to-ship fluorspar) and 29,958 tons of ready-to-ship fluorspar.

Stocks of fluorspar at mines or shipping points in the United States, 1935–36, by States, in short tons

State	1935			1936		
	Crude [1]	Ready-to-ship	Total	Crude [1]	Ready-to-ship	Total
California	50		50	50		50
Colorado	350	29	379	260	165	425
Illinois	[2] 4,269	[2] 22,684	[2] 26,953	8,875	13,679	22,554
Kentucky	19,143	[2] 17,119	[2] 36,262	14,370	16,051	30,421
Nevada	325	75	400	220		220
New Hampshire		30	30	200	11	211
New Mexico		52	52		52	52
Texas	48		48	48		48
Utah		[2] 54	[2] 54			
	[2] 24,185	[2] 40,043	[2] 64,228	24,023	29,958	53,981

[1] The greater part of this crude (run-of-mine) fluorspar must be beneficiated before it can be marketed.
[2] Revised figures.

INDUSTRY IN 1936, BY STATES

Arizona.—A carload of fluorspar was produced at the Luckie property near Duncan, Greenlee County, Ariz., in 1936. It was mined to obtain samples in order to test the grade and suitability of the material for certain purposes. The material was shipped to a steel plant.

Colorado.—Shipments of fluorspar from Colorado in 1936 were 9,412 short tons compared with 6,978 tons in 1935. Of the 1936 shipments 8,072 tons went to steel plants, 510 tons to iron foundries, and the rest to ferro-alloy and cement plants and nonferrous-metal refineries. Shipments in 1936 comprised 40 tons from Boulder County, 5,101 tons from Chaffee County, 15 tons from Jackson County, and 4,256 tons from Mineral County. Shipments from Colorado in 1936 were the largest since 1926, and those from Chaffee County were the largest since the field was opened. The movement of 26 carloads of fluorspar from Chaffee County to eastern markets indicates low production costs. Virtually all other fluorspar shipped from Chaffee County went to midwest consumers.

Illinois.—Increased demand for fluorspar in 1936 stimulated activity in Illinois and resulted in much prospecting and development work and in the mining, milling, and shipment of substantially greater quantities of fluorspar in 1936 than in 1935. In fact, shipments in 1936 were the largest since 1922. Several mines either inactive or virtually so in 1935 were reopened; the flotation plant of the Aluminum Ore Co., inactive since 1931, resumed operations; and a milling plant was under construction at the Cave in Rock mine.

Approximately 136,000 short tons of fluorspar-bearing material, equivalent to about 76,000 tons of merchantable fluorspar, were mined at 25 mines or prospects in Illinois in 1936 compared with about 87,000 tons, equivalent to about 40,000 tons of merchantable fluorspar, mined

at 18 mines or prospects in 1935. Of the merchantable fluorspar produced in 1936, 43,000 tons were from mines where the fluorspar occurs in veins, chiefly in fault fissures, and 33,000 tons from mines where the fluorspar occurs in flat-lying tabular masses, locally called blanket formations.

Fluorspar-bearing material milled in Illinois in 1936 totaled about 136,000 tons, from which 73,000 tons of merchantable fluorspar were recovered—a ratio of 1.863 : 1.

Shipments from Illinois were 82,056 tons in 1936 compared with 44,120 tons in 1935. Of the total, 32,344 tons were shipped by barge for delivery at upper Ohio River landings compared with 12,312 tons in 1935.

The chief producing mines in 1936 were the Stewart, Hamp, Crystal, Hillside, Lee, Daisy, Spar Mountain, Victory, and Douglas; these supplied about 89 percent of the total merchantable fluorspar produced. The remainder of the output came from the Lead Hill, Argo, Blue Diggings, Good Hope, Diamond, Rose, Humm, Preen, Cave in Rock, Eureka Nos. 1 and 5, Boundary Shaft, and Dimick mines and various small prospects.

The flotation plant at Rosiclare treated 9,058 short tons of ore and tailings in 1936, from which a considerable quantity of No. 1 concentrates suitable for use in the manufacture of hydrofluoric acid was recovered. The mill feed in 1936 included 1,203 tons of fluorspar-bearing material of Kentucky origin, and the concentrates recovered therefrom have been credited to Kentucky in the statistics.

Kentucky.—In Kentucky, as in Illinois, improved demand for fluorspar in 1936 resulted in renewed activity at several mines, reopening of the milling plant of the Aluminum Ore Co., improvements and additions to mill equipment, and considerable prospecting and development work. In fact, so great was the demand for Kentucky fluorspar that shipments (80,241 short tons) have been exceeded in only 1 year, 1918. Consequently, almost any source that would yield fluorspar was drawn upon. Although most of the output came from mines of the fissure-vein type, which use mechanical equipment and follow more or less orderly systems of mining, a considerable tonnage was reclaimed from mill ponds, waste dumps, old workings of abandoned mines, and numerous small prospects.

Production of merchantable fluorspar in Kentucky in 1936 was about 78,000 short tons compared with 51,300 tons in 1935, and shipments were 80,241 tons compared with 68,679 tons in 1935.

Fluorspar was mined at five properties in Caldwell County in 1936, but most of the output came from the Hollowell & Hobby mine. Production of merchantable fluorspar in the county was about 3,800 short tons compared with 2,400 tons in 1935.

Reopening of the Lafayette, Keystone, and Pigmy mines and increased output, chiefly at the Watson (Eagle) and Davenport mines, are evidenced by the production of about 38,500 tons of merchantable fluorspar in Crittenden County in 1936 compared with 19,400 tons in 1935. Although fluorspar was produced at a large number of small mines and prospects and reclaimed from an undetermined number of mill ponds, waste dumps, and old workings of abandoned mines, about three-fourths of the production in the county came from eight mines—the Memphis, Watson (Eagle), Lafayette, Keystone, Pigmy, Davenport, Blue & Marble, and Bachelor.

About 35,000 short tons of merchantable fluorspar were produced in Livingston County in 1936 compared with 29,500 tons in 1935. The chief producing mine was the Klondike, with an output of about 27,000 tons. The Nancy Hanks, John-Jim, C. R. Babb, and Bonanza mines were also important producers; the remainder of the output was from various small mines and prospects and from mill tailings.

The Faircloth mine near Wilmore, Woodford County, which had long been inactive, was reopened in 1936, and 650 tons of fluorspar (600 tons of fluxing gravel, 30 tons of foundry lump, and 20 tons of acid lump) were produced and shipped.

Nevada.—Shipments of fluorspar from Nevada were 2,126 short tons in 1936 compared with 1,040 tons in 1935 and were the largest ever recorded. Of the 1936 shipments, 2,084 tons went to steel plants, 34 tons to cement plants, and 8 tons (ground) to enamel manufacturers.

The chief producing mine in Nevada in 1936 was the Baxter in Mineral County, with record shipments of 1,890 tons. The other active mine was the Daisy in Nye County, which shipped 236 tons.

New Hampshire.—The fluorspar mine near Westmoreland, Cheshire County, shipped 257 short tons of fluorspar in 1936 compared with 12 tons in 1935. Shipments in 1936 comprised 226 tons to steel plants, 1 ton to foundries, and 30 tons of acid grade for use in the manufacture of hydrofluoric acid. The shaft at this mine was deepened and a second level started in 1936.

New Mexico.—Shipments of fluorspar from New Mexico were 2,045 short tons in 1936 compared with 2,726 tons in 1935 and comprised 1,748 tons of ground fluorspar and 297 tons of metallurgical run-of-mine fluorspar.

Production of fluorspar in New Mexico in 1936 came from deposits near Deming in Luna County and from a newly opened deposit near Silver City in Grant County.

Utah.—Shipments of fluorspar from Utah in 1936 were 54 tons of metallurgical gravel compared with 180 tons in 1935. The deposit, opened in 1935, is in Beaver County, and the ore is hauled 25 miles to Lund for shipment. The fluorspar is reported to be high-grade and the vein of considerable width.

TRENDS IN EMPLOYMENT AND OUTPUT PER MAN-HOUR

The following table gives details on employment at fluorspar mines and mills, the quantity of ore mined and milled, and the average output of fluorspar per man-hour for 1933–35 by years, States, and groups of States. Corresponding statistics by States and groups of States for the 6-year period 1926–31 and supplementary data are given in the chapter on Fluorspar and Cryolite in Minerals Yearbook, 1935. Although information on employment at all operations was not reported, the compilations include mines producing about 90 percent of the total output for the 3-year period 1933–35; therefore the figures are regarded as representative. The reports received from the producing companies do not include salaried officials and office workers or an undetermined number of employees engaged in hauling fluorspar, as such work usually is done on a contract basis, and no record of it is kept by the mining companies.

Employment at fluorspar mines and mills in the United States, quantity of ore mined and milled, and average output of fluorspar per man 1933–35, by States [1]

State	Employment at mines and mills [1]: Average number of men employed	Time employed: Average number of days	Time employed: Total man-shifts	Man-hours: Average per shift	Man-hours: Total	Crude ore mined (partly estimated): Total (short tons)	Crude ore mined, covered by study: Short tons	Crude ore mined, covered by study: Percent of total	Total crude ore [2] washed or milled (partly estimated) (short tons)	Total merchantable fluorspar recovered (short tons)	Covered by study, crude ores [2] washed or milled (partly estimated): Short tons	Covered by study, crude ores washed or milled: Percent of total	Merchantable fluorspar recovered: Short tons	Merchantable fluorspar recovered: Percent of total	Average pounds per man: Per shift	Average pounds per man: Per hour
1933																
Illinois	307	204	62,493	8.00	499,968	66,000	63,500	96.21	92,400	32,000	90,800	98.27	31,100	97.19	995	124
Kentucky	246	194	47,842	8.04	384,474	39,100	25,400	64.96	39,500	24,300	25,600	64.81	13,500	55.56	564	70
Colorado, Nevada, New Mexico	24	80	1,931	8.00	15,448	3,100	600	19.35	3,100	2,300	600	19.35	600	26.09	621	78
	577	195	112,266	8.02	899,890	108,200	89,500	82.72	135,000	58,600	117,000	86.67	45,200	77.13	805	100
1934																
Illinois	374	195	72,837	8.00	582,696	68,700	67,900	98.84	69,500	30,200	68,800	98.99	29,500	97.68	810	101
Kentucky	563	169	95,343	8.10	772,621	86,700	66,900	77.16	92,800	50,400	72,900	78.56	37,800	75.00	793	98
California, Colorado, Nevada, New Mexico	101	154	15,593	7.58	118,264	19,300	17,700	91.71	19,300	9,700	17,700	91.71	8,200	84.54	1,052	139
	1,038	177	183,773	8.02	1,473,581	174,700	152,500	87.29	181,600	90,300	159,400	87.78	75,500	83.61	822	102
1935																
Illinois	308	254	78,278	8.33	651,732	87,100	86,700	99.54	90,600	43,800	89,400	98.68	42,500	97.03	1,086	130
Kentucky	586	206	120,799	8.14	982,859	82,400	78,600	95.39	86,200	52,800	82,600	95.82	51,700	97.92	856	105
Colorado, Nevada, New Hampshire, New Mexico, Tennessee, Utah	104	171	17,828	8.00	142,624	18,300	17,600	96.17	18,300	10,900	17,100	93.44	10,100	92.66	1,133	142
	998	217	216,905	8.19	1,777,215	187,800	182,900	97.39	195,100	107,500	189,100	96.92	104,300	97.02	962	117

[1] Includes men and employment at mines and mills producing from 83 percent in 1933 to 97 percent in 1935 and averaging 90 percent of the total fluorspar produced during the 3-year period covered by study; excludes officials, clerks, and other subordinate salaried employees as well as all men engaged in contract hauling of fluorspar.
[2] Includes a comparatively small quantity of run-of-mine fluorspar not washed or milled.

IMPORTS AND EXPORTS[1]

The total imports of fluorspar for consumption in the United States were 25,504 short tons (10,028 tons containing more than 97 percent and 15,476 tons containing not more than 97 percent calcium fluoride) valued[2] at $259,262 in 1936, compared with 16,340 tons (10,578 tons containing more than 97 percent and 5,762 tons containing not more than 97 percent calcium fluoride) valued[2] at $170,049 in 1935. The value assigned to the foreign fluorspar in 1936 averaged $10.17 a ton. The cost to consumers in the United States also includes duty, loading charges at the docks, ocean freight, insurance, consular fee, and freight from docks to consuming points. The duty on fluorspar containing more than 97 percent calcium fluoride is $5 per short ton and on fluorspar containing not more than 97 percent calcium fluoride, $7.50.

Of the imports in 1936 about 61 percent was metallurgical-gravel fluorspar, 5 percent ceramic-ground fluorspar, and 34 percent acid (chiefly lump) fluorspar. The metallurgical-gravel fluorspar was imported from France, Germany, Newfoundland, and Spain; the ceramic-ground fluorspar from Germany and Spain; and the acid-grade fluorspar from Germany, Newfoundland, Spain, and Union of South Africa. Imports were equivalent to 14 percent of the total shipments of domestic fluorspar in 1936 compared with 13 percent in 1935.

Fluorspar imported for consumption in the United States, 1935–36, by countries

Country	Containing more than 97 percent calcium fluoride		Containing not more than 97 percent calcium fluoride		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1935						
Canada			1	$14	1	$14
Germany	8,585	$115,562	1,258	3,713	9,843	119,275
Italy			55	589	55	589
Spain	646	10,522	4,448	24,910	5,094	35,432
Union of South Africa	1,347	23,739			1,347	23,739
	10,578	149,823	5,762	29,226	16,340	179,049
1936						
France	224	2,293	1,371	13,746	1,595	16,039
Germany	6,801	102,117	6,142	58,820	12,943	160,937
Newfoundland	1,870	12,500	2,447	18,997	4,317	31,497
Spain	185	3,625	5,516	27,740	5,701	31,365
Union of South Africa	948	19,424			948	19,424
	10,028	139,959	15,476	119,303	25,504	259,262

The following table, compiled from data courteously furnished the Bureau of Mines by importers, shows the quantities of imported fluorspar delivered to consumers in the United States in 1935 and 1936 and the selling price at tidewater (duty paid), irrespective of the year

[1] Figures on imports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce; those on exports supplied by the producers. No exports of fluorspar recorded by the Bureau of Foreign and Domestic Commerce.

[2] As defined in sec. 402 of the tariff act of 1930, "The value of imported merchandise * * * is the foreign value or the export value, whichever is higher—that is, the market value or the price at which the merchandise, at the time of exportation to the United States, is offered for sale in the principal markets of the country from which exported, including the cost of containers or coverings and all expenses (including any export tax) incident to placing the merchandise in condition ready for shipment to the United States."

of importation into the United States; it differs from the preceding table, which shows the quantities received in the United States during 1935 and 1936. The quantities in this table are based on the actual outturn weight ascertained by sworn weighers and represent the weight on which duty was paid and entries were liquidated.

Imported fluorspar delivered to consumers in the United States, 1935–36

Industry	1935			1936		
	Short tons	Selling price at tidewater, including duty		Short tons	Selling price at tidewater, including duty	
		Total	Average		Total	Average
Steel	5,702	$102,635	$18.00	15,096	$287,454	$19.04
Glass	1,969	49,803	25.29	394	10,397	26.39
Enamel	920	24,447	26.57	544	15,428	28.36
Hydrofluoric acid	7,715	189,794	24.60	8,883	223,419	25.15
	16,306	366,679	22.49	24,917	536,698	21.54

Manufacturers of glass and enamel purchased a much smaller proportion of their fluorspar supply from importers in 1936 than in 1935. For example, in 1936 such manufacturers purchased 938 short tons from importers and 16,263 from domestic producers, whereas in 1935 they purchased 2,889 and 14,343 tons, respectively. In 1935 most of the acid-grade fluorspar was supplied by importers, but in 1936 the greater part came from domestic mines. Specifically, in 1936 domestic producers supplied 12,627 and importers 8,883 tons, whereas in 1935 domestic producers supplied 3,333 and importers 7,715 tons.

Producers of fluorspar reported exports of 240 short tons valued at $4,079 in 1936 compared with 313 valued at $4,651 in 1935. In both years all the fluorspar exported went to Canada.

Fluorspar reported by producers as exported from the United States, 1932–36

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1932	25	$553	$22.12	1935	313	$4,651	$14.86
1933	71	967	13.62	1936	240	4,079	17.00
1934	522	8,602	16.48				

FLUORSPAR IN FOREIGN COUNTRIES

Canada.[3]—The production of fluorspar in Canada was 75 short tons valued at $900 in 1936 compared with 225 tons valued at $2,700 in 1935. The output in both years was from Ontario.

Imports of fluorspar into Canada were 11,194 tons valued at $95,268 in 1936 compared with 11,591 valued at $92,775 in 1935.

France.—France was an annual exporter of fluorspar to the United States from 1924 to 1933, and in 1930 exports reached 23,313 short tons. Since 1933, however, chiefly owing to the unfavorable rate of

[3] Dominion Bureau of Statistics, Preliminary Report on the Mineral Production of Canada During the Calendar Year 1936; Ottawa, 1937, p. 36.

exchange, France has been unable to export fluorspar to this country at a profit. The more favorable rate of exchange since September 28, 1936, prompted resumption of exports of fluorspar to the United States and 1,595 short tons were received during the last quarter of 1936. Moreover, during the 3 months from January to March 1937 imports from France totaled 4,949 short tons, indicating that France may become one of the chief importing countries in 1937.

Presumably the fluorspar being imported from France is from the same deposits that formerly furnished supplies, as the exported fluorspar is loaded at the port of San Raphael. The deposits are in the eastern end of the Department of Var near the French Riviera seacoast, where three mines—Font Sante, Garot, and Les Adrets, about 9 to 15 miles north of Frejus—were developed and put in operation about August 1925, producing an aggregate of 100 tons a day. The output of the mines is taken to Frejus by trucks, and that for export is shipped to the port of San Raphael by rail.

Germany.—The United States continues to be the largest export outlet for German fluorspar, taking 9,095 metric tons in 1935.[4] Czechoslovakia took 5,582 tons, Poland 4,138 tons, Austria 3,576 tons, and Sweden 3,126 tons. Germany's total exports were 31,425 tons in 1935, 31,756 tons in 1934, and 24,907 tons in 1933.

Fluorspar production in Germany comes from 26 mines which employ a total of 708 persons. The output increased from 70,045 metric tons in 1934 to 98,414 in 1935. Domestic consumption has advanced sharply the last few years because of increased metallurgical and general manufacturing activities in Germany. Probably 60 percent of the total consumption is for fluxing.

Union of South Africa.—According to the Department of Mines[5] of the Union of South Africa:

> A flotation plant has recently been erected with a view to producing fluorspar of about 200-mesh and of the following specifications: Calcium fluoride, 98 percent minimum; silica, 1 percent maximum; and calcium carbonate, 1 percent maximum. The lump spar at present being exported is of the same specifications.
>
> Another producer has erected a small plant and in addition to lump spar can supply ground spar containing calcium fluoride not below 90 percent, maximum $CaCO_3$ 1 percent, silica 4 percent, water under 0.25 percent. The ground spar is supplied in the following mesh per linear inch—100-mesh, 85 percent; 150-mesh, 80 percent; 200-mesh, 70 percent.

Newfoundland.—The deposits of fluorspar in the Districts of Burin East and Burin West, Newfoundland, at which mining was begun in 1933, yielded about 10,000 short tons of fluorspar in 1936, and production of 17,000 tons is contemplated for 1937. Shipments in 1936 totaled 9,368 short tons, of which 1,822 tons of acid grade and 2,358 tons of fluxing grade went to consumers in the United States, 2,007 tons of special-grade lump (93 to 95 percent CaF_2) to Ontario, and 3,181 tons of fluxing grade to Nova Scotia. In 1935 production was 6,500 short tons and shipments were 4,500 tons, all of which went to Ontario and Nova Scotia.

U. S. S. R. (Russia).—It is reported[6] that an extensive and high-grade deposit of fluorspar near Amderma (an Arctic Ocean port with 2,000 inhabitants) is being developed. During 1934, 9,000 metric

[4] Jesien, W. S., consular clerk, Frankfurt-am-Main, Germany, Oct. 28, 1936.
[5] Department of Mines, Union of South Africa, Pretoria, Industrial Minerals: Quarterly Inf. Circ., August 1936, p. 23.
[6] Izvestia, Sept. 27, 1935.

tons of fluorspar were mined, and a daily output of 400 tons is contemplated for a concentrating plant. Fresh water is difficult to obtain, so sea water may have to be used.

According to the publication, Socialistic Construction of the U. S. S. R., production of fluorspar in Russia was 49,100 metric tons in 1935 and 27,000 in 1934.

WORLD PRODUCTION

World production of fluorspar, 1932–36, by countries, in metric tons

[Compiled by M. T. Latus]

Country	1932	1933	1934	1935	1936
Argentina [1]	10	200	311	(2)	(2)
Australia:					
New South Wales	---------	51	203	420	(2)
Queensland	1,240	749	1,328	185	(2)
South Australia	41	201	234	91	(2)
Canada	29	66	136	204	68
China	3,510	4,800	5,050	(2)	(2)
Chosen	7,577	9,076	12,099	9,722	(2)
France	15,200	15,050	14,100	(2)	(2)
Germany:					
Anhalt	(2)	(2)	7,357	8,068	(2)
Baden	(2)	(2)	6,527	3,941	(2)
Bavaria	21,915	26,364	29,661	31,277	(2)
Prussia	7,794	10,653	21,555	24,618	(2)
Saxony	2,656	3,672	4,945	6,938	(2)
Thuringia	(2)	(2)	(2)	23,572	(2)
Italy	6,450	7,714	9,668	9,500	(2)
Mexico [3]	900	900	900	900	(2)
Newfoundland (shipments)	---------	1,451	2,535	4,082	8,498
Norway	571	507	673	(2)	(2)
South-West Africa	610	---------	---------	---------	---------
Spain	7,018	3,564	6,365	(2)	(2)
Switzerland [3]	1,000	1,000	1,000	1,000	1,000
U. S. S. R. (Russia)	11,200	19,300	27,000	49,100	(2)
Union of South Africa	1,317	445	1,393	1,955	3,101
United Kingdom	15,675	28,508	34,765	31,646	(2)
United States (shipments)	22,907	66,161	77,823	112,255	159,873

[1] Railway shipments. [2] Data not available. [3] Estimated annual output.

CRYOLITE

Cryolite occurs in commercial quantity and is mined at only one place—Ivigtut, Greenland. Most of the purified cryolite is used in the metallurgy of aluminum and in making opaque glass, and smaller quantities are used in enamels and glazes. Considerable ground cryolite is used in insecticides. Although finely divided cryolite resulting from the purification process has been so used for many years, an efficient method of grinding cryolite to a fineness that would permit its use for insecticides was discovered recently.

Gibbs [7] has described the mine at Ivigtut, grades of ore produced, methods of processing and purification, and various uses of cryolite. According to Gibbs:

> * * * The mine at Ivigtut is owned by the Danish State, and the mining concession belongs to the A/S Kryolith Mine og Handels Selskabet, Copenhagen. This firm divides all the raw material between the Pennsylvania Salt Manufacturing Co. of Philadelphia, which has the North American rights; and the Oresunds Chemiske Fabriker, Kommanditselskake, ved C. F. Jarl, Copenhagen, which

[7] Gibbs, Arthur E. (technical director, Pennsylvania Salt Manufacturing Co.), Cryolite as a Chemica Raw Material: Chem. Ind., vol. 38, May 1936, pp. 471–476.

controls the manufacture and sale in the rest of the world. * * * In 1865 the Danish company made a contract with the Pennsylvania Salt Manufacturing Co. for two-thirds of all the cryolite produced, and a plant was erected by the Salt company at Natrona, near Pittsburgh, for the refinement of the cyrolite. * * *

The Greenland deposit lies on the shore and under a fjord, the open pit being separated from the water by a bank some 50 feet wide. The cryolite mine itself consists of slopes operating from the bottom of an open quarry, about 500 feet long running northeast to southwest. The north end is 60 feet wide, and the pit widens to 160 feet at the other end with a depth of 150 feet. At the northwest side of the pit an arm of cryolite extends out toward the fjord, and this is reported as the portion of the deposit now being worked.

Ivigtut and the surrounding plateau is underlain with granitic and hornblendic gneisses, probably of the pre-Cambrian era. The gneisses are cut by numerous dikes of diabase. The cryolite associated with much pegmatitic material lies entirely within a small intrusive mass of porphoritic granite, a pink formation of quartz, orthoclase phenocrysts, and biotite, which appears to be of the mother rock of the fluoride deposit.

Along the northwest wall of the quarry some green altered granite is enclosed in the cryolite. This mass consists mostly of quartz and sericite (a hydrous iron aluminum silicate containing some fluorine). At the bottom of the pit are ledges of green sericitized granite. Associated minerals led to the assumption that this cryolite deposit was an intrusive igneous mass rather than one formed by strictly water deposition, as in the case of several small deposits in Russia and in the western part of the United States.

At the mine in Greenland, a large part of the associated nonfluoride minerals are culled out. The impurities found in the cryolite ore as delivered to the Pennsylvania Salt Manufacturing Co.'s purification plant at Natrona fall into three classes: Fractions which separate out of the molten magma; products of partial interaction between the native rock and the fluoride; and products of substitution within the mass brought about by circulating waters. * * *

Due to the variety of impurities in the ore, several methods of purification have been developed. First the crude ore is screened to get rid of the very fine material in which the iron has oxidized and permanently discolored the cryolite. Then hand picking removes the fluorspar, topaz, and as much of the siderite as is free. The next stage is crushing all through ¼-inch mesh, after which the mineral is passed on continuous rubber belts under high-power magnets which remove the magnetic impurities including siderite and part of the pyrite. Following the magnets the ore is separated into two sizes (the coarser of which passes over two types of jigs) to remove galena and pyrite in the first and silica, hagemannite, thompsenolite, and other minerals in the second. The finer sizes pass over Wilfley tables and then over jigs for removal of silica, etc. After drying and further magnetic treatment, the two sizes are remixed and ground with porcelain balls in a porcelain-lined mill. An air-separator system insures a fineness in the finished product of at least 99 percent through 150-mesh and 90 percent through 300-mesh. * * *

Imports.—The following table shows imports of cryolite into the United States in 1935 and 1936 by countries. As cryolite is mined only in Greenland, it is evident that importations credited to countries other than Greenland include artificial cryolite and reexports of natural cryolite.

Cryolite imported for consumption in the United States, 1935-36, by sources

Source	1935		1936	
	Long tons	Value	Long tons	Value
Asia			37	$7,424
Canada	637	$71,850	972	107,169
Denmark	10	1,936		
France	323	15,246	125	19,220
Germany	1,029	173,321	2,121	371,078
Greenland	6,300	384,000	9,351	570,000
Netherlands	(1)	37	10	1,647
	8,299	646,390	12,616	1,076,538

[1] Less than 1 ton.

FELDSPAR

By R. W. Metcalf

SUMMARY OUTLINE

The feldspar industry broke all previous production records in 1936. The output of crude spar in the United States rose to 244,726 long tons, an increase of 29 percent over the previous year and 16 percent more than the record established in 1928. The value of the crude feldspar produced in 1936 was $1,303,090, or 30 percent more than in the preceding year.

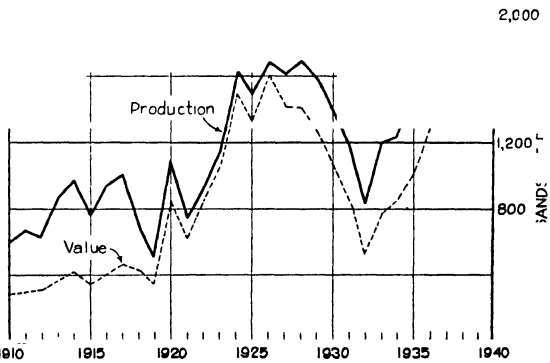


FIGURE 109.—Trends in production and value of crude feldspar in the United States, 1910–36.

The glass industry was chiefly responsible for this large expansion The production of glass containers and illuminating glassware increased 20 percent over 1935. The relatively larger amount of feldspar used in the manufacture of glass has contributed in large degree to the recovery of the industry. A few years ago the glass industry took less than a third of the total feldspar consumed, but it now takes well over half of the total. Other consuming industries likewise improved in 1936. The potters bought more feldspar and, due to the sharp increase in residential building, the demand for enamel and sanitary ware increased greatly.

The average value per long ton of domestic crude spar in 1936 was $5.32, only slightly higher than the value in 1935, when the average was $5.30 per ton.

The increase in production of crude spar in 1936 was shared by all the producing States except Maine and Pennsylvania. New Hampshire had the largest percentage gain (71 percent), followed by California (56 percent), South Dakota (45 percent), and Virginia (38 percent). North Carolina, the largest producing State, registered the largest absolute gain in output, 19,984 tons, although this was only 24 percent more than in 1935. In Maine production declined 4 percent.

South Dakota attained second place among producing States in 1936. New Hampshire ranked third, exceeding Colorado by a small margin.

Sales of ground feldspar by merchant mills in 1936 amounted to 236,890 short tons valued at $3,154,853, more than 18 percent greater tonnage and value than in 1935. This is a new record and is all the more remarkable in view of changing markets, more exacting standards of production and use, and increasing competition from other mineral raw materials.

The total sales of ground spar include 14,764 short tons prepared from crude spar imported from Canada. Included, also, in the total is a substantial tonnage of so-called "Carolina stone", a domestic synthetic product used much the same as natural Cornwall stone, a kaolinized feldspar. This material is covered by United States Patent 2020407.

Salient statistics of the feldspar industry in the United States, 1935-36

	1935	1936	Percent of change in 1936
Crude feldspar:			
Domestic sales:			
Long tons	189,550	244,726	+29.1
Value	$1,005,021	$1,303,090	+29.7
Average per long ton	$5.30	$5.32	+.4
Imports:			
Long tons	8,937	10,786	+20.7
Value	$56,175	$68,198	+21.4
Average per long ton	$6.29	$6.32	+.5
Ground feldspar sold by merchant mills:			
Domestic:			
Short tons	189,289	222,126	+17.3
Value	$2,460,073	$2,884,493	+17.3
Average per short ton	$13.00	$12.99	-.1
Canadian:			
Short tons	10,806	14,764	+36.6
Value	$199,067	$270,360	+35.8
Average per short ton	$18.42	$18.31	-.6
Total:			
Short tons	200,095	236,890	+18.4
Value	$2,659,140	$3,154,853	+18.6

Markets.—As feldspar is used extensively in the manufacture of enamel and sanitary ware, the industry shared in the increased activity in building construction in 1936. The output of bathroom accessories rose to 7,192,807 pieces in 1936, a gain of 143 percent over the 2,964,820 pieces reported produced in 1935. The value of shipments of porcelain-enameled flatware was 27 percent higher than in 1935, and sales of electric refrigerators for household use increased 30 percent. Sales of electrical porcelain likewise increased sharply, shipments of

special and standard porcelain advancing 36 and 29 percent, respectively.

In the glass industry, now by far the largest single market, ground feldspar is valued chiefly for its alumina content, although the potash and soda likewise are useful additions to the batch. Glass-container shipments in 1936 increased 21 percent compared with 1935, and output of illuminating glassware rose 20 percent, approximately the same increase as for total sales of ground spar by merchant mills. No data are available on production of opaque structural glass, tile, or pottery—also important outlets for feldspar.

In 1936, sales of ground feldspar were distributed by industries as follows: Glass, 51.4 percent; pottery, 32.3 percent; enamel and sanitary ware, 10.0 percent; brick and tile, 2.6 percent; electrical insulators and other porcelain, 2.1 percent; other ceramic uses, 0.8 percent; scouring soaps and abrasives, 0.6 percent, other uses (chiefly for abrasive wheel binder), 0.2 percent. The distribution in 1935 was almost the same, but only a few years ago the glass industry accounted for only 30 percent, general ceramic uses took 15 percent, electrical porcelain 13 percent, tile 11 percent, sanitary ware 9 percent, enamel 9 percent, soaps and abrasives 7 percent, and miscellaneous uses 6 percent.

Ground feldspar sold by merchant mills in the United States, 1934–36, by uses, in short tons

Use				Use	1934 [1]		1936
Glass	56,726	103,499	121,677	Other ceramic uses	87	1,511	1,839
Pottery	28,689	66,451	76,527	Scouring soaps and abrasives	1,015	350	1,328
Enamel and sanitary ware	9,643	21,014	23,746	Binder for abrasives	1,027	241	584
Insulators and other porcelain goods	5,346	4,058	5,105	Other uses	211	3	10
Brick and tile	2,447	2,965	6,074		[1] 105,191	200,095	236,890

[1] Data for 1934 cover 73 percent of the total ground spar sold by merchant mills in the United States; data by uses not available for the other 27 percent in that year. Distribution shown for 1935 and 1936 is for total sales.

Capacity.—Maintenance of a productive capacity considerably in excess of current demand has been characteristic of the feldspar-grinding industry for many years. To determine the present capacity of the industry, the Bureau requested the producers of ground spar to report the tonnage of ground feldspar that could have been produced during 1936, working the usual number of hours a day, assuming a continuous demand, and allowing for unavoidable shut-downs for repairs or other unforeseen delays. Mills producing 208,327 short tons, about 88 percent of the total ground spar in 1936, reported an aggregate capacity of 467,850 tons, which would indicate an approximate total capacity of grinding equipment in the industry of 531,000 short tons. This figure is computed from data of active mills only, processing both domestic and Canadian spar.

Prices.—According to Engineering and Mining Journal Metal and Mineral Markets, prices on all grades of feldspar quoted remained at the same levels throughout 1936. Prices on North Carolina grades were: Potash and soda spar, 200-mesh, f. o. b. North Carolina, $17 and $19 per ton respectively; granular glass spar, 20-mesh, f. o. b. mine, $12.50 per ton; and semigranular spar, $11.75. Maine white potash spar, 200-mesh, and Virginia No. 1, 200-mesh, were quoted at $17 per ton. Quotations on Virginia spar No. 1, 230-mesh, were

unchanged at $18 per ton. Quoted prices of other Virginia spars follow: No. 17, glassmakers' $11.75 per ton; No. 18, $12.50, and enamelers' spar, $14 to $16, f. o. b. Virginia.

The average realization on all sales of ground feldspar by merchant-mill operators rose from $13.29 in 1935 to $13.32 in 1936.

Nepheline syenite.—During 1936, a new competitor arose in the form of nepheline syenite. Trial shipments of this material have been imported from Canada, and some of the earlier shipments, particularly those from Bancroft, occasionally ran rather high in iron. Now, however, production comes from Blue Mountain, Methuen Township, where a large, uniform deposit is being prepared for large-scale production. The material is crushed and cleaned magnetically at Lakefield, Ontario, the shipping point. Plans have been drawn for the erection of a crushing and screening plant in northern New York State. At present a duty of 30 percent ad valorem, or approximately $3 a ton, is levied on imports of the prepared material, which is ground to pass 28-mesh (13 percent through 200-mesh) for use in the glass industry. The material as mined carries about 1 percent iron oxides; but these are present mainly as magnetite, and after treatment in magnetic separators the typical analysis is as follows: SiO_2, 59.30; Al_2O_3, 24.70; Fe_2O_3, 0.05; TiO_2, 0.01; CaO, 0.27; MgO, 0.02; Na_2O, 9.91; K_2O, 5.10; and loss, 0.44.

Ordinary feldspar seldom contains over 18 percent alumina, and even South Dakota spar rarely exceeds about 20 percent. Nepheline syenite, however, carries 24 percent alumina and also contains a slightly higher total amount of alkalies. It is sold in Canada at $10 a ton and is offered at $18.38, delivered at glass works in western Pennsylvania and Ohio.

As a result of extensive tests on syenite in semivitreous ware, Koenig states [1] that direct substitution of syenite for feldspar produced increased vitrification. Warpage was definitely less and firing shrinkage slightly less for syenite bodies, while modulus of rupture and modulus of elasticity were about the same. The vitrification range of the syenite bodies compared favorably with that of a feldspar body. Syenite bodies had a high coefficient of expansion. A glaze of standard formula containing syenite gave promising results.

Other competitive products.—Another substitute for feldspar may be available soon in the form of a byproduct of certain chemical-manufacturing operations. Preliminary samples indicate the possibility of maintaining a product with the composition of a synthetic sodium-aluminum silicate with over 33 percent alumina. Reports from Barre, Vt.,[2] state that porcelain has been produced experimentally from pulverized or waste granite and china clay. Froth flotation has been suggested for removal of undesirable mica and iron.

Another mineral definitely competitive with feldspar in certain of its uses is spodumene, a lithium aluminosilicate abundant in South Dakota, North Carolina, and Maine. The United States Bureau of Mines recently investigated the possibilities of its use in the ceramic and other industries. Two lines of approach have given satisfactory

[1] Koenig, C. J., Use of Syenite in Semivitreous Ware. I. (a) Physical Properties of Bisques, and (b) A Glaze Containing Syenite: Jour. Am. Ceram. Soc., 19, 1936 pp. 295–8; Chem. Abs., vol. 30, no. 22, Nov. 20, 1936, p. 8547.

[2] Pit and Quarry, vol. 28, no. 5, November 1936, p. 29.

results—flotation concentration [3] and disintegration by heat. Hitherto, the expansive properties of spodumene at working temperatures have prevented its use, especially in pottery. Under the latter process, beta-spodumene, the easily disintegrated chalky white mass formed by the heating to which the matrix mineral is subjected, has already been expanded. Its uses, aside from pottery manufacture, include production of lithium salts, storage batteries, and special types of extremely tough glass.[4]

Some displacement of feldspar may accompany the larger use of pyrophyllite and magnesium talc, particularly in the manufacture of wall tile. The substantial increase in production of wall tile, however, more than offset any such quantitative displacement in 1936. The Vitrefrax Corporation, Los Angeles, Calif., is mining trachites near Mojave, Calif., to completely replace feldspar and partly replace china clay and flint in porcelain bodies. An approximate analysis of this material shows that it contains about 45 percent flint, 43 percent feldspar, and 12 percent china-clay equivalents; it is said to produce a superior product.

DEVELOPMENTS IN THE INDUSTRY

The National Feldspar Association, an organization comprising most of the feldspar producers in the industry, with offices at 19 West Forty-fourth Street, New York, N. Y., has been issuing a monthly statistical service covering shipments of ground feldspar and deliveries to mills of crude spar based on periodic reports from members. The feldspar industry is making rapid strides in technologic research and has greatly improved the uniformity of its product and extended the variety of its grades, each of which is available in a number of different grindings. A summary of the cooperative research conducted under the auspices of the association is soon to be released.

The Feldspar Miners Association, representing producers of between 75 and 80 percent of the feldspar output of North Carolina and Virginia, has been organized at Spruce Pine, N. C. One of the main objectives of the Association is to maintain uniform wages and hours in conformity with agreements in effect since the abolition of the N. R. A.[5]

The United States Bureau of Mines and the Ceramic Research Division of the Tennessee Valley Authority, in cooperation with producers in the Spruce Pine district, North Carolina, have been investigating the possible use of lower-grade spars in the preparation of a high-grade finished product.[6] Tests of new methods of processing indicate the possibility of reducing quarrying and refining costs.

Company developments.—During 1936 the Consolidated Feldspar Corporation completed extensive improvements to its plant at Erwin, Tenn., involving crushing, screening, and dust-collecting equipment and new magnetic separators for reducing the iron content of high-grade spar. The Consolidated Feldspar Corporation also has under construction a new mill for processing feldspar at Canon City, Colo., at an expected cost of about $100,000. This firm is reported to be

[3] Ralston, Oliver C., The Nonmetallics: Eng. and Min. Jour., February 1937, p. 94.
[4] Fraas, Foster, and Ralston, Oliver C., Beneficiation of Spodumene by Decrepitation: Rept. of Investigation 3336, Bureau of Mines, 1937, 13 pp.
[5] Rock Products, vol. 39, no. 12, December 1936, p. 56.
[6] Rock Products, vol. 39, no. 7, July 1936, p. 33.

considering the erection of a crushing and treating plant for feldspar in Baltimore, Md., also at an estimated cost of about $100,000.[7]

The North Carolina Feldspar Corporation has been operating a new grinding mill at Erwin, Tenn., since the latter part of 1935, the major equipment including a Hardinge conical mill, a 14-foot Gayco separator, and a Jeffrey-Taylor vibrating screen.[8] The North State Feldspar Corporation, with plant at Micaville, N. C., discontinued business early in 1936.

The F. E. Schundler Feldspar Co., affiliated with the F. E. Schundler Co., which for some years has been grinding spar at Joliet, Ill., erected a new grinding plant at Custer, S. Dak., which operated during the last 2 months of 1936. In addition to the new mill being erected by the Consolidated Feldspar Corporation in Colorado, the Colorado Feldspar Co. has installed machinery and is planning to start grinding spar at its new $100,000 plant at Canon City early in 1937. Crude spar is to be obtained from Fremont County.[9] The Western Feldspar Milling Co., Denver, Colo., has built an addition to house equipment for its glass-spar operations. New equipment also is to be installed for treating pottery spar.[10]

In the East, there have been several new developments. The Seaboard Minerals Corporation, 52 William Street, New York, N. Y., began operating its plant at Cold River, N. H., in 1935. The Ceramic Feldspar Co., Bath, Maine, took over the plant formerly known as the Cummings Feldspar Co., and started grinding operations early in 1936. The Trenton Flint & Spar Co., Trenton, N. J., with grinding plant at Cathance, Maine, is reported to be out of business. The White Hill Mineral Co., Gouverneur, N. Y., has reopened the mines and processing plant formerly operated by the Green Hill Mining Co. of Gouverneur. The grinding mill is reported to have a daily capacity of about 75 tons.[11]

REVIEW OF INDUSTRY BY STATES

The term "crude feldspar" is applied to lump spar shipped from the mine or quarry, contrasted with ground spar, the finished product of crushing and pulverizing equipment. Statistics of production are presented separately for crude and ground spar; in accordance with the usual practice in the industry, the crude is reported in long tons of 2,240 pounds and the ground in short tons of 2,000 pounds.

Normally, the tonnage of ground spar produced from domestic crude is about 87 percent of the crude-spar output, the remaining 13 percent representing spar sold for purposes that do not require fine grinding and that lost or discarded during the grinding process. In spite of an 18 percent increase in output of ground spar in 1936, sales of domestic ground feldspar did not advance as sharply as crude, indicating substantial accumulation of crude stocks.

Crude feldspar.—Production of crude feldspar in the United States in 1936 totaled 244,726 long tons valued at $1,303,090, an increase of 29 percent in tonnage and 30 percent in value over 1935. The tonnage exceeded the output of 1928, the previous peak year, by 16 percent. The average realization for crude spar at the mine increased slightly,

[7] Pit and Quarry, vol. 28, no. 11, May 1936, p. 46.
[8] Pit and Quarry, vol. 29, no. 2, Aug. 1936, p. 38.
[9] Pit and Quarry, vol. 28, no. 8, February 1937, p. 46.
[10] Rock Products, vol. 40, no. 1, January 1937, p. 74.
[11] Pit and Quarry, vol. 28, no. 10, April 1936, p. 32.

from $5.30 a ton in 1935 to $5.32 in 1936. Although in 1936 the spread between high and low values per ton was somewhat less than in other years, sales realizations per long ton ranged from $2.46 to $10 for individual producers. In New England the average value ranged from $4 to $8.68; for New York, Pennsylvania, and Virginia, from $3.38 to $7.28; for North Carolina, from $4 to $8.19; and for the Western States, from $2.46 to $10.

Average values for the larger producing States are much more illuminating and indicate clearly the difference between sales realizations in the Western States and in the New England and Southern Appalachian regions. Thus, the average values per long ton of crude spar produced in Colorado and South Dakota in 1936 were $3.95 and $3.23, respectively, while those for New Hampshire and Maine were $5.95 and $5.57. In the Southern Appalachian district average realization per ton was $5.77 in North Carolina and $5.61 in Virginia.

Crude feldspar sold or used by producers in the United States, 1932–36

Year	Long tons	Value		Year	Long tons	Value	
		Total	Average			Total	Average
1932	104,715	$539,641	$5.15	1935	189,550	$1,005,021	$5.30
1933	150,633	778,826	5.17	1936	244,726	1,303,090	5.32
1934	154,188	853,136	5.53				

Twelve States produced crude feldspar in 1936—the same States that produced spar in 1935, except Nevada. North Carolina, the largest producer of crude spar, increased production from 82,499 long tons in 1935 to 102,393 tons in 1936, or nearly 20,000 tons (24 percent) more than in the previous year. South Dakota rose to second place with 32,144 tons, and New Hampshire's output totaled 26,494 tons, 71 percent more than in 1935. Colorado dropped into fourth place, with a crude production of 25,806 long tons. The output of spar in Virginia advanced to 20,459 tons in 1936. Maine reported production of 16,392 tons, a small decrease from 1935. The other producing States in 1936, in order of importance, were New York, California, Connecticut, Arizona, Maryland, and Pennsylvania.

Crude feldspar sold or used by producers in the United States, 1934–36, by States

[Value is at mine or nearest shipping point]

State	1934		1935		1936	
	Long tons	Value	Long tons	Value	Long tons	Value
Arizona	(1)	(1)	(1)	(1)	(1)	(1)
California	(1)	(1)	3,015	$21,105	4,700	$41,050
Colorado	(1)	(1)	22,275	64,151	25,806	101,950
Connecticut	(1)	(1)	(1)	(1)	(1)	(1)
Maine	14,685	$82,854	17,103	99,770	16,392	91,265
Maryland	(1)	(1)	(1)	(1)	(1)	(1)
Nevada	(1)	(1)	(1)	(1)	----	----
New Hampshire	12,119	80,733	15,490	115,089	26,494	157,729
New York	6,262	37,275	5,468	39,904	(1)	(1)
North Carolina	79,844	465,214	82,499	482,729	102,393	591,053
Pennsylvania	64	456	245	1,847	144	828
South Dakota	9,190	30,892	22,099	62,498	32,144	103,671
Virginia	12,140	64,529	14,810	81,474	20,459	114,807
Undistributed	19,884	91,183	6,546	36,454	16,194	100,737
	154,188	853,136	189,550	1,005,021	244,726	1,303,090

[1] Included under "Undistributed".

Ground feldspar.—Feldspar consumed for virtually all industrial purposes is finely ground before use. Even spar used for facing cement blocks and covering prepared roofing is crushed and roughly sized by screening. A canvass of all consumers of feldspar to determine quantities used by them has not been practicable. However, all known merchant mills or grinders—that is, those that mine, quarry, or purchase crude spar and grind it for sale to other establishments—have been canvassed in recent years.

Sales of ground feldspar by merchant mills in 1936 advanced to 236,890 short tons valued at $3,154,853, the highest tonnage sold in any year. Production was 18 percent greater than in 1935, and the value of the output increased 19 percent. Thirty mills operated in 1936; these were owned by 23 producing companies in 14 States. Spar of domestic origin was ground by 26 mills and spar imported from Canada was ground by 4 mills. Domestic spar accounted for 94 percent of the total quantity processed compared with about 95 percent in both 1935 and 1934.

Ground feldspar sold by merchant mills [1] in the United States, 1932–36

Year	Number of active mills	Domestic			Canadian			Total	
		Short tons	Value		Short tons	Value		Short tons	Value
			Total	Average		Total	Average		
1932	27	104, 289	$1, 174, 833	$11. 27	3, 460	$65, 659	$18. 98	107, 749	$1,240,492
1933	25	126, 418	1, 491, 904	11. 80	6, 590	125, 648	19. 07	133, 008	1, 617, 552
1934	26	136, 820	1, 731, 528	12. 66	7, 358	136, 972	18. 62	144, 178	1, 868, 500
1935	29	189, 289	2, 460, 073	13. 00	10, 806	199, 067	18. 42	200, 095	2, 659, 140
1936	30	222, 126	2, 884, 493	12. 99	14, 764	270, 360	18. 31	236, 890	3, 154, 853

[1] Does not include potters or others who grind for consumption in their own plants.

The average value of the ground feldspar produced from domestic crude in 1936 was $12.99 per short ton, slightly less than for 1935. The average value for the various States ranged from $7.37 to $20.54 per ton. The realization figures for Colorado and South Dakota in 1936 were $7.37 and $9.66 per ton, respectively, considerably under the average values for certain of the larger eastern feldspar-grinding States. Average sales realizations in the Eastern States were as follows: Maine, $14.65 per ton; New Jersey, $19.88; and North Carolina-Tennessee, $13.53. Ground spar produced from Canadian crude in 1936 averaged $18.31 per ton, slightly less than in 1935.

North Carolina remained the largest producer of ground spar, followed by Tennessee, Colorado, and South Dakota. These four States in 1936 produced 59 percent of the total spar ground (North Carolina-Tennessee, 36 percent; Colorado, 12 percent; and South Dakota, 11 percent). The other larger producing States, in order of importance, were New York, Maine, New Hampshire, New Jersey, and Virginia; Illinois, California, Ohio, Arizona, and Minnesota produced smaller amounts.

Production of ground spar in 1936 increased in all States except Minnesota, in which the output declined slightly; and Virginia, where output was virtually the same as in 1935. Production in North Carolina-Tennessee, South Dakota, Colorado, Maine, New Hampshire, New Jersey, and New York increased substantially compared

with 1935. The tonnage reported by most of the States that normally produce smaller amounts also showed large proportional increases.

Ground feldspar sold by merchant mills[1] in the United States, 1935–36, by States

State	1935					1936				
	Number of active mills	Domestic		Canadian		Number of active mills	Domestic		Canadian	
		Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
Arizona	1	(2)	(2)			1	(2)	(2)		
California	1	2,694	$37,552			3	4,189	$68,461		
Colorado	1	22,320	166,071			1	28,034	206,550		
Illinois	2	(2)	(2)			2	(2)	(2)		
Maine	4	14,154	212,486			3	17,293	253,258		
Minnesota	1			(2)	(2)	1			(2)	(2)
New Hampshire	2	(2)	(2)			2	(2)	(2)		
New Jersey	3	13,091	260,297			3	14,430	286,940		
New York	4	(2)	(2)	8,556	$164,734	4	(2)	(2)	(2)	(2)
Ohio	2	(2)	(2)	(2)	(2)	2	(2)	(2)	(2)	(2)
North Carolina	4	78,012	1,043,979			3	85,240	1,153,466		
Tennessee	2					2				
South Dakota	1	(2)	(2)			2	26,486	255,888		
Virginia	1	(2)	(2)			1	(2)	(2)		
Undistributed		59,018	739,688	2,250	34,333		46,454	659,930	14,764	$270,360
	29	189,289	2,460,073	10,806	199,067	30	222,126	2,884,493	14,764	270,360

1 Does not include potters or others who grind for consumption in their own plants.
2 Included under "Undistributed."

IMPORTS[12]

Imports of crude feldspar, which amounted to 8,937 long tons valued at $56,175 in 1935, rose to 10,786 long tons valued at $68,198 in 1936. This imported spar was largely Canadian in origin, United Kingdom supplying only 154 tons valued at $1,039. Ground spar imported from Canada totaled 33 tons valued at $301, and 99 tons valued at $975 were imported from the United Kingdom.

Imports of unmanufactured Cornwall stone in 1936 more than doubled 1935 receipts, totaling 2,061 long tons valued at $18,402, compared with 817 tons valued at $7,449 in 1935. Imports of ground Cornwall stone rose to 357 tons valued at $4,730 in 1936, compared with 242 tons valued at $3,180 in 1935. All imports of both crude and ground material in 1936 originated in the United Kingdom. More complete data on imports of Cornwall stone appear in Minerals Yearbook, 1934, page 1003.

Feldspar imported for consumption in the United States, 1931–36

Year	Crude		Crushed or ground		Year	Crude		Crushed or ground	
	Long tons	Value	Short tons	Value		Long tons	Value	Short tons	Value
1931	10,719	$95,096	79	$1,500	1934	9,744	$67,258		
1932	1,872	14,346	28	218	1935	8,937	56,175	1	$106
1933	3,239	21,877	30	242	1936	10,786	68,198	132	1,276

12 Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

WORLD PRODUCTION

Feldspar is produced chiefly in the United States, Sweden, Norway, China, Canada, and probably Czechoslovakia, although no official data on the Czechoslovak output are available. The greater part of the Canadian output of crude spar is shipped to the United States for grinding.

Available figures on world production of feldspar follow:

World production of feldspar, 1932–36, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1932	1933	1934	1935	1936
Argentina (shipments)	369	376	431	(2)	(2)
Australia:					
New South Wales [3]	590	2,037	891	166	(2)
South Australia [3]	65	112	212	315	(2)
Western Australia (exports)	367	460	1,845	2,703	(2)
Canada (shipments)	6,393	9,669	16,603	16,095	16,234
China	26,858	27,189	27,780	(2)	(2)
Egypt	179	60	----------	72	(2)
Finland (exports)	1,529	2,706	3,329	2,071	(2)
Germany (Bavaria)	3,550	4,490	6,808	5,954	(2)
India, British	481	688	638	713	(2)
Italy	5,217	4,861	7,637	7,616	(2)
Norway (exports)	13,015	17,986	22,139	24,228	29,985
Rumania	681	1,309	1,026	(2)	(2)
Sweden	23,693	32,567	34,468	48,637	(2)
United States (shipments)	106,396	153,051	156,663	192,592	248,654

[1] In addition to countries listed, feldspar is produced in Czechoslovakia. Official figures of output are not available, but it is estimated that the annual production is approximately 30,000 metric tons. (Stat. Comm. Czechoslovak Ceram. Soc.)

[2] Data not available.

[3] Includes some china stone.

ASBESTOS

By Oliver Bowles and M. A. Cornthwaite

SUMMARY OUTLINE

The United States, with several hundred factories manufacturing asbestos products, leads all countries in output of these important commodities. In 1936, as in previous years, domestic deposits furnished only a small percentage of the requirements of raw asbestos. Small quantities of high-grade chrysotile of spinning quality are obtained in Arizona, and an increasing tonnage of short-fiber chrysotile is produced in Vermont. Small quantities of nonspinning anthopyhllite (amphibole asbestos) are produced in Maryland, North Carolina, and Montana. As indicated in the table of salient statistics that follows, domestic sources furnished only 4.4 percent of the consumption in 1936. Foreign supplies were obtained chiefly from Canada, U. S. S. R. (Russia), and British Africa.

The varieties, properties, history, production, occurrences throughout the world, uses, mining and milling methods, classification, and marketing of asbestos and the manufacture of asbestos products are covered in some detail in Bureau of Mines Bulletin 403, entitled "Asbestos", published in 1937.

Domestic production amounted to 10,845 short tons in 1936 compared with 9,415 tons in 1935, an increase of 15.2 percent. Asbestos sold or used by producers in 1936 (11,012 tons valued at $309,994) increased 23.5 percent in quantity and 5.8 percent in value over 1935. Compared with 1935 the apparent consumption of asbestos in the United States in 1936 increased 43.6 percent in quantity and 41.2 percent in value. The value of exports of asbestos products increased 9.6 percent.

Salient statistics of the asbestos industry in the United States, 1935-36

	1935		1936	
	Short tons	Value	Short tons	Value
Domestic asbestos:				
Produced:				
Chrysotile	(1)	(2)	10,441	(2)
Amphibole	(1)	(2)	404	(2)
Total	9,415	(2)	10,845	(2)
Sold or used by producers:				
Chrysotile	(1)	(1)	10,667	$298,134
Amphibole	(1)	(1)	345	11,860
Total	8,920	$292,927	11,012	309,994
Imports (unmanufactured)	166,585	5,125,413	243,602	7,524,937
Exports (unmanufactured)	850	87,896	3,744	310,197
Apparent consumption	174,655	5,330,444	250,870	7,524,734
Exports of asbestos products	(2)	2,261,929	(2)	2,479,273

[1] Bureau of Mines not at liberty to publish figures separately for chrysotile and amphibole.
[2] Figures not available.

Consumption trends.—The following table of apparent consumption of raw asbestos, value of products manufactured, and value of products exported shows major trends in recent years. Apparent consumption is determined by adding imports (unmanufactured) to domestic asbestos sold or used by producers and subtracting exports (unmanufactured). No data are available to make adjustments for variation in consumers' stocks.

Raw asbestos consumed in the United States and asbestos products manufactured in and exported from the United States, 1932-36

Year	Raw asbestos—apparent consumption	Asbestos products: Manufactured [1] (value)	Asbestos products: Exported [2] (value)	Year	Raw asbestos—apparent consumption	Asbestos products: Manufactured [1] (value)	Asbestos products: Exported [2] (value)
	Short tons				*Short tons*		
1932	98,606	(1)	$1,608,880	1935	174,655	$58,815,424	$2,261,929
1933	122,909	$43,716,852	1,743,140	1936	250,870	(1)	2,479,273
1934	123,752	(1)	2,142,514				

[1] Figures of Bureau of the Census (collected biennially for odd years) include value of certain gaskets packing, and similar products in which little asbestos was employed.
[2] Compiled from the records of the Bureau of Foreign and Domestic Commerce.

The volume of asbestos consumption depends primarily on two great industries, automobile manufacture and the building trades. Large quantities of asbestos are used for making brake bands and clutch facings for automobiles, and in the building industries asbestos is employed for heat insulation or as a constituent of asbestos-cement products, such as roofing and wallboard. Figure 110 illustrates trends in automobile and building industries and in consumption of asbestos during recent years.

Market conditions.—The demand for asbestos improved steadily throughout the year. It was stimulated by a moderate increase in building activity and by a decided upturn in automobile production.

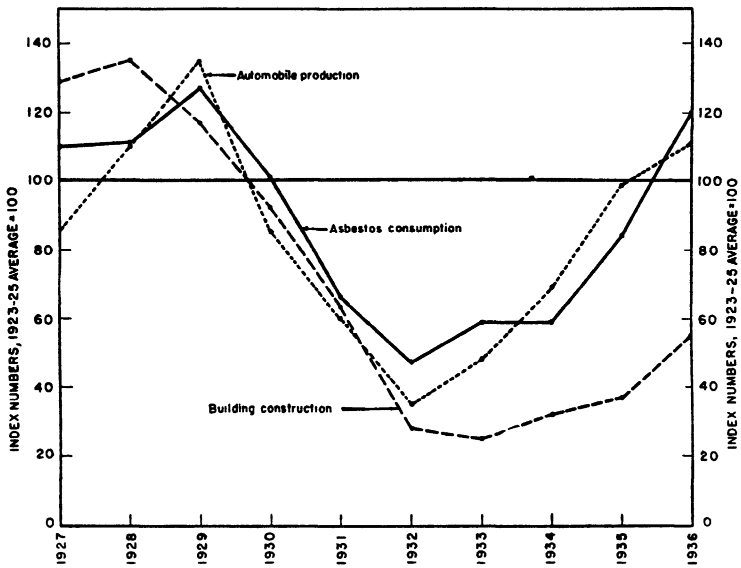


FIGURE 110.—Asbestos consumption compared with automobile production and building construction, 1927–36. Unlike units are reduced to percentages of the 1923–25 average. Statistics of asbestos are from the Bureau of Mines, automobiles from the Bureau of the Census, and building contracts from the Federal Reserve Board.

Prices.—According to quotations in Metal and Mineral Markets the prices of some grades of Canadian fiber were advanced in March 1936, after which prices per ton were constant throughout the year as follows: Crude No. 1, $550; Crude No. 2, $200–225; spinning fibers, $90–150; magnesia and compressed sheet fibers, $100–110; shingle stock, $45–75; paper stock, $32.50–37.50; cement stock, $19–23; and floats, $16–18.50.

Rhodesian Crude No. 1 was quoted at $210 and Crude No. 2 at $185 a ton throughout the year.

From March to December 1936, Russian Crude AA was quoted at $475, No. 1 at $225, No. 2 at $190, and shingle stock at $55.

Vermont prices were constant throughout the year: Shingle stock, $47.50; paper stock, $35; cement stock, $23; and shorts, $11–12.

Canadian prices are f. o. b. Quebec mines, tax and bags included; Rhodesian and Russian, c. i. f. New York; and Vermont prices f. o. b. mines, Vermont.

REVIEW BY STATES

Arizona.—A small tonnage of Arizona chrysotile asbestos was sold in 1936 by the Arizona Asbestos Corporation, Los Angeles, Calif.; The Bear Canyon Asbestos Co., Globe, Ariz.; and the Johns-Manville Products Corporation, New York, N. Y.

California.—A deposit of chrysotile, some of which will grade as No. 1 Crude, is reported near Chicago Park, Nevada County. No development work has been done.

Maryland.—The Powhatan Mining Corporation continued production of anthophyllite near Pylesville, Harford County, and prepared it for use in chemical filters.

Montana.—The Karstolite Co. mined anthophyllite near Gallatin Gateway, Gallatin County, and sold it prepared for wall and ceiling insulation.

North Carolina.—The National Asbestos Co. produced a small tonnage of anthophyllite at Minneapolis, Avery County. It was processed and sold for use in home insulation similar to that of mineral wool.

Oregon.—Samples of chrysotile asbestos of good quality, said to have been obtained in Malheur County, were submitted to the Bureau of Mines. No information is available as to the location or extent of the deposit.

Vermont.—Since the Ruberoid Co. assumed control of the asbestos property near Eden, Lamoille County, the mill has been so enlarged and improved that its output will be doubled. With new equipment "floats" will be recovered, and a special grade of fiber for molded brake linings will be prepared. The operating firm is the Vermont Asbestos Corporation, 500 Fifth Avenue, New York, N. Y.

FOREIGN TRADE [1]

Imports.—The following table shows imports of unmanufactured asbestos into the United States in 1935 and 1936. Of the crude fibers imported, Canada furnished only about 29 percent and Africa about 70 percent. The importation of nearly 17,000 tons of mill fiber from Hungary is noteworthy. As there is no record of production in Hungary the material doubtless originated in some other country, probably in the U. S. S. R. (Russia).

Asbestos (unmanufactured) imported into the United States, 1935–36, by countries and classes

Country	Crude (including blue fiber)		Mill fiber		Stucco and refuse		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935								
Africa, British:								
Union of South Africa	945	$121,577					945	$121,577
Other British	1,183	172,654					1,183	172,654
Canada	1,548	301,352	58,484	$2,713,895	94,204	$1,470,865	154,236	4,486,112
Finland					11	446	11	446
Italy	22	11,464			523	5,202	545	16,666
Malta, Gozo, Cyprus					4,628	87,844	4,628	87,844
Morocco	22	2,131					22	2,131
U. S. S. R. (Russia)	18	7,351	4,614	206,347	181	834	4,813	214,532
United Kingdom	202	23,451					202	23,451
	3,940	639,980	63,098	2,920,242	99,547	1,565,191	166,585	5,125,413
1936								
Africa, British:								
Union of South Africa	2,080	246,171					2,080	246,171
Other British	3,266	412,138					3,266	412,138
Canada	2,281	432,004	56,184	2,972,137	150,538	2,469,910	209,303	5,874,051
Finland			22	840	59	1,528	81	2,368
Hungary			16,775	516,713			16,775	516,713
Italy	30	22,030			1,044	14,187	1,074	36,217
Malta, Gozo, Cyprus					4,386	91,706	4,386	91,706
U. S. S. R. (Russia)	35	5,972	6,382	300,300			6,417	306,272
United Kingdom	220	39,236	([1])	65			220	39,301
	7,912	1,157,551	79,663	3,790,055	156,027	2,577,331	243,602	7,524,937

[1] Less than 1 ton.

[1] Data on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Exports.—The following table shows exports of asbestos products in 1935 and 1936.

Manufactured asbestos products exported from the United States, 1935–36, by kinds

Product	1935		1936	
	Quantity	Value	Quantity	Value
Brake lining:				
Molded and semimolded	(1)	$651,338	(1)	$670,979
Not molded ... linear feet	1,426,520	231,381	1,963,029	276,925
Clutch facing ... number			316,585	77,065
Paper, millboard, and roll board ... short tons	767	130,578	630	110,129
Pipe covering and cement ... do	1,233	143,357	1,665	134,391
Textiles, yarn, and packing ... do	715	662,321	665	676,835
Asbestos roofing ... squares	31,141	106,678	41,459	142,335
Other asbestos manufactures, except roofing ... short tons	921	190,208	1,354	217,065
Magnesia and manufactures ... do	922	146,068	1,051	173,531

[1] Quantity not recorded.

WORLD PRODUCTION

Asbestos production is centered chiefly in Quebec (Canada), Southern Rhodesia, the Union of South Africa, the U. S. S. R. (Russia), United States, and Cyprus. Relatively small quantities are produced in Italy, Australia, Finland, and several other countries. The following table shows world production, by countries. from 1932 to 1936, insofar as figures are available.

World production of asbestos, 1932–36, by countries, in metric tons [1]

[Compiled by M. T. Latus]

Country	1932	1933	1934	1935	1936
Argentina	[2] 7				(3)
Australia:					
South Australia	20	13		36	(3)
Western Australia	112	270	157	143	(3)
Brazil	37	99	(3)	(3)	(3)
Bulgaria			3	3	(3)
Canada [4]	111,562	143,667	141,502	190,931	273,322
China	250	236	290	(3)	(3)
Chosen		12	4	6	(3)
Cyprus [5]	1,626	4,640	7,712	7,634	9,659
Czechoslovakia	(3)	1,200	2,100	2,600	(3)
Finland	756	1,340	1,735	1,742	(3)
France	300	400	(3)	(3)	(3)
Greece	9	14	30	(3)	(3)
India, British	91		25	64	(3)
Italy	1,284	3,267	2,252	(3)	(3)
Japan [6]	1,000	1,000	1,000	1,000	1,000
Southern Rhodesia	14,303	27,381	29,224	38,644	51,116
Swaziland	5				(3)
Turkey	58	120	4	104	(3)
Union of South Africa	10,950	14,411	15,960	20,683	22,162
U. S. S. R. (Russia)	59,800	71,700	92,200	95,500	[6] 130,000
United States (sold or used by producers)	3,229	4,305	4,615	8,092	9,990
Venezuela				76	(3)

[1] In addition to countries listed, Bolivia and Madagascar are reported to produce small quantities of asbestos.
[2] Rail and river shipments.
[3] Data not available.
[4] Exclusive of sand and gravel, production of which is reported as follows: 1932, 3,151 tons; 1933, 5,847 tons; 1934, 4,238 tons; 1935, 2,744 tons; 1936, 2,815 tons.
[5] Exports.
[6] Approximate production.

CANADA

The strong upturn in production that characterized the Canadian asbestos industry in 1935 was continued in 1936. Output increased 43 percent in quantity and 41 percent in value over that of 1935. The entire production was from the eastern townships of the Province of Quebec. The following table shows production in 1936 as published in the Preliminary Report on the Mineral Production of Canada in 1936, issued by the Dominion Bureau of Statistics.

Sales of asbestos in Canada, 1935–36

	1935			1936		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Grade:						
Crudes	2, 278	$539, 558	$236. 86	3, 440	$790, 971	$229. 93
Fibers	102, 270	4, 873, 255	47. 65	133, 288	6, 483, 946	48. 65
Shorts	105, 919	1, 641, 801	15. 50	164, 559	2, 683, 266	16. 31
	210, 467	7, 054, 614	33. 52	301, 287	9, 958, 183	33. 05
Sand, gravel, and stone (waste rock only)	3, 025	2, 053	. 68	3, 103	2, 356	. 76
Total asbestos and waste rock	213, 492	7, 056, 667		304, 390	9, 960, 539	
Rock mined	2, 852, 118			4, 692, 004		
Rock milled	2, 256, 994			3, 568, 992		

AFRICA

Rhodesia.—Production of asbestos in Southern Rhodesia in 1936 was the highest on record, exceeding that of the former peak year, 1929, by 32 percent. The value, however, was 29.5 percent lower than in 1929. The lower average value per ton during recent years indicates that a larger proportion of lower grades are now demanded, particularly for the expanding asbestos-cement products industries of Europe. That prosperity has returned is shown by the fact that Turner & Newall, Ltd., the principal producer in Rhodesia and the largest manufacturer of asbestos products in the British Empire, paid a dividend of 17½ percent on the ordinary stock for the year ended September 30, 1936, compared with 12½ percent for 1934–35 and 10 percent for 1933–34. The following table shows Rhodesian production from 1927 to 1936.

Asbestos produced in Rhodesia, 1927–36

Year	Short tons	Value	Year	Short tons	Value
1927-31 (average)	35, 515	£881, 702	1934	32, 214	£402, 745
1932	15, 766	197, 092	1935	42, 598	646, 658
1933	30, 182	555, 993	1936	56, 346	836, 469

Union of South Africa.—Asbestos production in the Union of South Africa in 1936 increased 7.9 percent over that of 1935 but was still 25.5 percent below the peak production of 1929. The following table shows the output from 1927 to 1936.

Asbestos produced in the Union of South Africa, 1927–36, by sources

Year	Short tons				Total value
	Trans-vaal	Cape Province	Natal	Total	
1927-31 (average)	17,820	5,013	5	22,838	£365,524
1932	9,106	2,964		12,070	116,401
1933	12,662	3,225		15,887	197,120
1934	14,783	2,810		17,593	203,033
1935	20,379	2,420		22,799	226,881
1936	21,504	2,925		24,429	[1] 330,375

[1] Value of local sales plus value of exports.

The Union of South Africa is unique in that it produces four different kinds of asbestos. Because of a change in the method of tabulating returns the value for 1936 is not comparable with that of previous years. The following table shows the tonnage of each variety produced in the Transvaal and Cape Provinces from 1932 to 1936.

Asbestos produced in the Union of South Africa, 1932–36, by varieties and sources, in short tons

	1932	1933	1934	1935	1936 [1]
Amosite (Transvaal)	1,391	3,090	3,757	4,684	[2] 6,035
Chrysotile (Transvaal)	7,715	9,572	11,025	15,620	15,085
Blue (Transvaal)			1	75	384
Blue (Cape)	2,964	3,225	2,810	2,420	2,925
	12,070	15,887	17,593	22,799	24,429

[1] Data from Quarterly Information Circulars, Union of South Africa, Department of Mines.
[2] Includes 73 tons anthophyllite.

U. S. S. R. (RUSSIA)

As indicated in the following table Russian production has made substantial gains since 1932. Exports have not increased proportionally, a condition that reflects the growing importance of the asbestos-products manufacturing industries in that country. In 1935 nearly three-fourths of the tonnage produced was used in domestic factories.

Production and exports of Russian asbestos, 1932–36, in metric tons

Year	Production	Exports	Year	Production	Exports
1932	59,800	[1] 16,551	1935	95,500	[1] 25,109
1933	71,700	[1] 21,458	1936	[2] 130,000	[1] 26,147
1934	92,200	[1] 33,715			

[1] U. S. Bureau of Foreign and Domestic Commerce, Foreign Trade Notes.
[2] Official estimate.

CYPRUS

Tunnel Asbestos Cement, Ltd., a subsidiary of the Tunnel Portland Cement Co. of West Thurrock, England, continued production of short-fiber chrysotile at Amiandos. A substantial gain in production is recorded for 1936. The following table, compiled mainly from the Annual Report of the Inspector of Mines and Labour, shows exports during recent years. The entire production is exported.

Asbestos exported from Cyprus, 1932–36

Year	Long tons	Value	Year	Long tons	Value
1932	1,600	£27,214	1935	7,513	£50,174
1933	4,567	[1] 44,088	1936	9,506	80,343
1934	7,590	[1] 73,562			

[1] Reported by Cyprus & General Asbestos Co., Ltd.

OTHER COUNTRIES

Australia produces a small quantity of asbestos; production centers particularly in the Roebourne district of Western Australia. Finland produces a considerable quantity of short fiber annually, and Italy is a steady producer on a small scale. Production has been reported at times in China, India, Czechoslovakia, France, Bulgaria, and Austria.

BARITE AND BARIUM PRODUCTS[1]

By Bertrand L. Johnson and M. A. Cornthwaite

SUMMARY OUTLINE

The crude barite industry of the United States in 1936 was characterized by increases in quantity of crude barite mined; quantity and value of sales; new supply, of which domestic shippers furnished 89 percent; and consumption. Imports of crude barite decreased in quantity, total value, and average value. Sales of barium products decreased in total quantity and value, and imports of barium products decreased in quantity but increased in value. The total quantity and value of exports of lithopone increased.

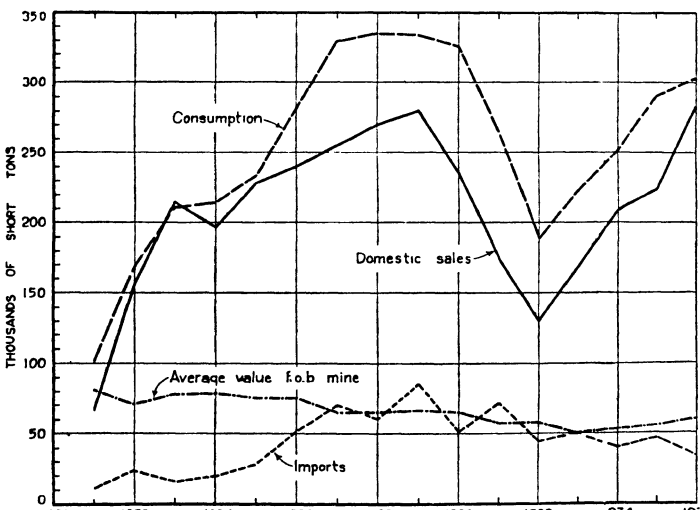


Figure 111.—Trends in domestic sales, imports, consumption, and average value f. o. b. mines of crude barite, 1921–36.

Figure 111 shows recent trends in sales of crude barite from domestic mines, imports, consumption, and average value per ton in the United States.

Salient statistics covering barite and the leading barium products are summarized for recent years in the following table.

---

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Salient statistics on barite and barium products in the United States, 1932–36

	1932	1933	1934	1935	1936
Crude barite:					
Produced.................short tons..	133,572	146,402	178,361	218,075	274,062
Sold or used by producers:					
Short tons........................	129,854	167,880	209,850	225,111	283,160
Value: [1]					
Total........................	$745,955	$852,611	$1,109,378	$1,251,268	$1,674,631
Average........................	$5.74	$5.08	$5.29	$5.56	$5.91
Imports for consumption:					
Short tons........................	45,758	49,958	40,031	47,047	33,843
Value: [2]					
Total........................	$177,954	$216,955	$174,937	$246,254	$170,316
Average........................	$3.89	$4.34	$4.37	$5.23	$5.03
Apparent new supply [3]....short tons..	175,612	217,838	249,881	272,158	317,003
Domestic..............percent..	73.9	77.1	84.0	82.7	89.3
Reported consumption (total) short tons..	189,409	223,047	250,476	290,344	303,449
Barium products:					
Sold or used by producers:					
Short tons........................	177,836	215,525	228,796	268,652	263,810
Value........................	$12,191,374	$14,170,890	$15,173,923	$16,858,413	$16,299,448
Imports for consumption:					
Short tons........................	10,561	12,236	9,259	11,672	11,076
Value........................	$385,662	$464,812	$475,262	$404,601	$411,797
Exports of lithopone:					
Short tons........................	3,212	1,186	2,401	2,372	2,538
Value........................	$270,195	$107,923	$199,508	$221,611	$229,942

[1] F. o. b. mine shipping point.
[2] Declared value f. o. b. foreign market.
[3] Barite sold or used by producers plus imports.

CRUDE BARITE

Production.—The production of crude barite in the United States comes from three areas—the southern, midwestern, and Pacific. About four-fifths of the crude produced in the southern area is shipped to eastern and the rest to midwestern markets. A little ground barite is produced in the local mills. The midwestern area, of which Missouri is the leading producing State, supplies midwestern consumers; only a small part of the production reaches other markets. Production in the Pacific area in recent years has come from California, Nevada, and Arizona, and virtually all of it is consumed on the Pacific coast.

Crude barite was mined in six States in 1936, and seven in 1935; South Carolina did not appear as a producer in 1936. Producing States in 1936 were as follows: Pacific area, California and Nevada; midwestern area, Missouri; and southern area, Georgia, Tennessee, and Virginia. Mined production in 1936 totaled 274,062 short tons—55,987 tons more than in 1935.

Sales.—Sales of crude barite in 1936 totaled 283,160 short tons valued at $1,674,631 compared with 225,111 tons valued at $1,251,268 in 1935. All six producing States sold crude barite in 1936, Missouri (with numerous producers) leading with 160,866 short tons. In the other producing States sales in 1936 were reported by all the producers in Georgia (four), Nevada (three), and Virginia (two); in California there were three producers in 1936, but only two of them made sales; and in Tennessee only two producers reported production and sales in 1936, but sales are reported to have been made also by two other companies.

Crude barite sold or used by producers in the United States, 1935–36, by States

State	1935		1936	
	Short tons	Value	Short tons	Value
Georgia	30, 577	$178, 254	38, 435	$206, 336
Missouri	131, 921	727, 888	160, 866	1, 008, 528
Other States [1]	62, 613	345, 126	83, 859	459, 767
	225, 111	1, 251, 268	283, 160	1, 674, 631

[1] 1935: California, Nevada, South Carolina, Tennessee, and Virginia; 1936: California, Nevada, Tennessee, and Virginia.

Prices.—Market quotations for crude barite, f. o. b. mines, from Georgia remained the same in 1936 as in 1935. The price quotations for Missouri crude (95 percent barium sulphate, less than 1 percent iron), however, ranged in 1936 from $5.50 to $7 per short ton compared with a slightly greater range, $5 to $7 per ton, in 1935. The average value f. o. b. mine shipping point for the entire United States, as calculated from values and tonnages reported by producers to the Bureau of Mines, increased from $5.56 in 1935 to $5.91 in 1936.

Range of price quotations on barite, 1934–36 [1]

	1934	1935	1936
Crude barite, f. o. b. mines:			
California ....per short ton..	$6.00	$6.00	....
Georgia ....do....	7.00	7.00	$7.00
Missouri [2] ....do..	5.00	5.00–7.00	5.50–7.00

[1] Metal and Mineral Markets, New York (weekly).
[2] 95 percent barium sulphate, less than 1 percent iron.

Markets for crude barite.—The markets for crude barite in the United States are three widely separated areas—the eastern, midwestern, and Pacific. The main competitive market in the East is supplied largely from imports and shipments from the Southern States. Ordinarily, less than 1 percent of the domestic barite sold in this area comes from Missouri. The midwestern market obtains most of its supply from Missouri, but about 20 percent comes from Georgia and Tennessee. The small Pacific coast demand is met with barite from mines in Nevada and California. Virtually no barite from other domestic or foreign sources enters this market.

Consumption by uses.—The barite-consuming industries of the United States used 303,449 short tons of domestic and imported barite in 1936 compared with 290,344 short tons in 1935, an increase of 13,105 tons. Changes in the distribution of this crude barite according to specified consuming industries are shown in the following table. Figure 112 shows trends in the consumption of crude barite for the principal uses in percentages of total consumption.

Crude barite consumed in the production of barium chemicals was 27 percent of the total in 1931 but subsequently decreased, comprising only 17 percent in 1935 and 1936. The percentage used for production of ground barite, which decreased from 1926 to 1931, increased to 32 percent in 1935 but fell to 28 in 1936. The percentage of crude barite consumed in the production of lithopone, the principal use, increased

to 55 percent of the total consumption in 1936 compared with 50 percent in 1935.

Crude barite (both domestic and imported) used in the manufacture of barium products in the United States, 1932–36, in short tons

Year	In manufacture of—			Total
	Ground barite	Lithopone	Barium chemicals	
1932	36, 402	120, 378	32, 629	189, 409
1933	38, 026	131, 761	53, 260	223, 047
1934	61, 123	140, 734	48, 619	250, 476
1935	93, 692	146, 164	50, 488	290, 344
1936	83, 990	167, 014	52, 445	303, 449

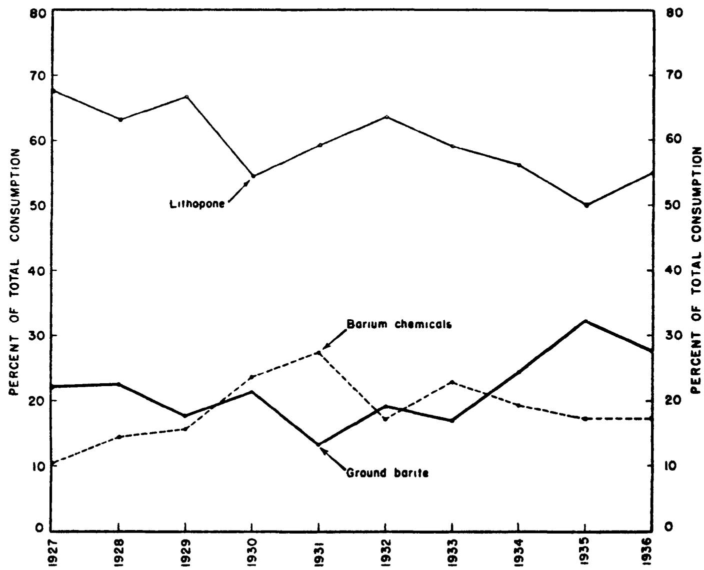


FIGURE 112.—Crude barite (domestic and imported) used in the manufacture of barium products in the United States, 1927–36, in percent of total consumption.

Figure 113 shows the relationship of the indexes of barite consumption and lithopone sales (1923–25 average=100) to industrial production, as represented by the Federal Reserve Board index of industrial production (1923–25 average=100).

Consumption by States.—Crude barite was consumed in 30 plants in 12 States in 1936, the same as in 1935. California, with 5 plants in 1936, instead of 4 as in 1935, is in the Pacific market area; Missouri with 4 plants in 1936 instead of 5 as in 1935, Illinois with 6 plants, and Kansas with 1 plant (a total of 11 plants) are in the midwestern area; and the remaining 8 States, with 14 plants, lie in the eastern area.

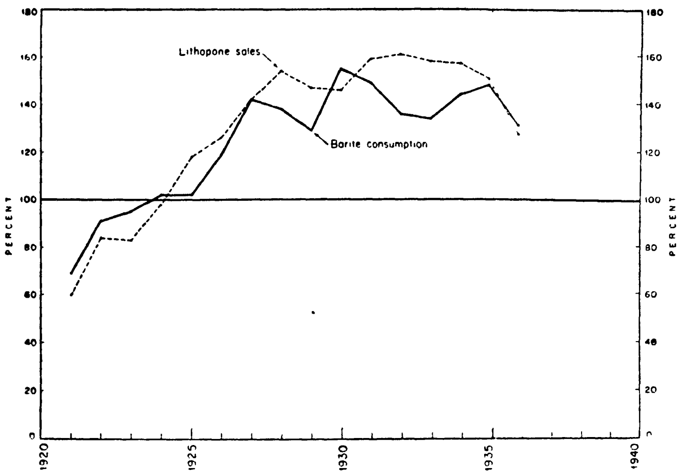


FIGURE 113.—Ratio of indexes of crude barite consumption and domestic lithopone sales (1923-25 average = 100) to Federal Reserve Board index of industrial production (1923-25 average=100), 1921-36.

Domestic and imported crude barite used in the manufacture of barium products in the United States in 1936, by States

State	Product manufactured	Plants [1]	Barite used (short tons)
Delaware, New Jersey, and Pennsylvania.	Ground barite, lithopone, and chemicals	6	88,174
Illinois	do	6	67,613
Missouri	Ground barite and chemicals	4	61,385
California	Ground barite, lithopone, and chemicals	5	30,698
West Virginia	Lithopone and chemicals	2	55,579
Maryland	do	1	
Georgia	Ground barite and chemicals	2	
Kansas	Lithopone	1	
New York	Ground barite	2	
South Carolina	do	1	
		30	303,449

[1] A plant producing more than 1 product is counted only once in calculating State totals.

Foreign trade.—Total imports of crude barite, which dropped from 85,729 short tons in 1929 to 40,031 tons in 1934, increased to 47,047 tons in 1935 and again dropped in 1936 to 33,843 short tons valued at $170,316. Imports from Germany declined to a new low of only 110 short tons, having dwindled steadily from 41,117 tons in 1931. The Netherlands was by far the leading source of crude barite imports in 1936, shipping 26,714 tons to this country, an increase of about 6,000 tons over 1935. France, with 5,040 tons, was the second largest shipper of crude barite to the United States in 1936; Italy, with 1,213 tons, ranked third. Spain furnished 15,401 tons of barite in 1935 compared with only 22 tons in 1936.

Exports of crude barite from the United States are not separately recorded.

Crude barite imported into the United States, 1935–36, by countries

Country	1935		1936	
	Short tons	Value	Short tons	Value
China			1	$14
Cuba			183	894
France	1,018	$5,073	5,040	27,000
Germany	6,720	42,700	110	1,305
Greece	3	50	560	2,917
Italy			1,213	4,400
Netherlands	20,752	120,228	26,714	133,671
Spain	15,401	58,465	22	115
U. S. S. R. (Russia)	3,153	19,738		
	47,047	246,254	33,843	170,316

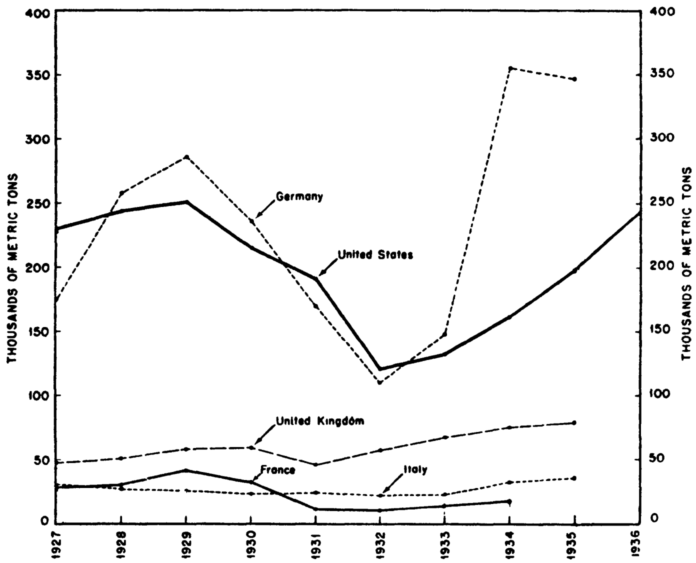


FIGURE 114.—World production of crude barite, by countries, 1927–36

World production.—The following table shows the output of barite in various countries from 1932 to 1936, as far as statistics are available.

Germany is by far the largest producer of crude barite; most of its production comes from Prussia, although Baden, Bavaria, Saxony, and Thuringia also contribute. The United States, United Kingdom, Italy, and France also produce large quantities of barite.

Figure 114 shows graphically the output of the principal barite-producing countries from 1927 to 1936, insofar as statistics are available.

World production of barite, 1932–36, in metric tons

[Compiled by M. T. Latus]

Country	1932	1933	1934	1935	1936
Algeria	890	16			(1)
Australia:					
New South Wales	309	323	187	208	(1)
South Australia	1,728	1,800	2,345	2,378	(1)
Tasmania		5			(1)
Austria	275	1,030	1,025	797	1,663
Brazil	(1)	1,229	891	(1)	(1)
Canada		18			
China	505	3,092	9,500	(1)	(1)
Chosen	6,569	4,969	5,935	11,027	(1)
Egypt			50	85	(1)
France	10,400	13,700	18,350	(1)	(1)
Germany:					
Baden	(1)	(1)	19,681	12,445	(1)
Bavaria	5,853	4,146	8,385	7,073	(1)
Prussia [2]	102,167	143,465	326,318	326,950	(1)
Saxony	2,446	130	484	222	(1)
Thuringia	(1)	(1)	(1)	554	(1)
Greece			7,853	(1)	(1)
India, British	3,004	5,742	3,874	5,581	(1)
Italy	21,861	23,444	32,408	35,600	(1)
Portugual		2	1		(1)
Southern Rhodesia			14		
Spain	8,934	4,605	17,528	(1)	(1)
U. S. S. R. (Russia)	24,300	31,000	74,800	(1)	(1)
United Kingdom	57,548	67,689	75,182	79,386	(1)
United States	121,174	132,813	161,806	197,833	248,624

[1] Data not available.
[2] Official figures which, it is reported, cover only output of mines included under the mining law.

BARIUM PRODUCTS

Sales.—Sales of ground barite, lithopone, and blanc fixe were less than in 1935. The decreases in sales of ground barite and lithopone interrupted a continuous recovery in sales of these products from the depression of 1932. The lower 1936 figure for blanc fixe, however, represents a continuation of the decline which began in 1934 following a sharp recovery from the 1932 low. Sales of artificial barium carbonate and other barium chemicals were greater in 1936 than in 1935.

Lithopone sales for floor coverings and textiles and rubber were larger in 1936 than in 1935, but other outlets took less.

Barium products sold or used by producers in the United States, 1932–36 [1]

Year	Ground barite			Lithopone			Blanc fixe (precipitated barium sulphate)		
	Plants	Short tons	Value	Plants	Short tons	Value	Plants	Short tons	Value
1932	12	33,842	$563,902	11	121,667	$10,176,856	7	14,454	$933,068
1933	13	34,601	683,432	11	140,831	11,751,500	9	30,744	1,197,131
1934	13	53,326	1,005,905	11	145,565	12,235,624	6	18,115	1,084,733
1935	11	76,250	1,407,787	11	159,486	13,470,274	6	18,067	980,191
1936	13	69,102	1,217,818	11	158,319	12,976,754	6	16,149	890,310

[1] To avoid duplication, the barium chemicals reported here do not include the output of firms that make these chemicals from such products as barium chemicals and imported barite and witherite purchased in the open market; the total for barium chemicals is therefore not shown here.

Barium products sold or used by producers in the United States, 1932–36—Con.

Year	Artificial barium carbonate (chemically precipitated)			Barium chloride			Other barium chemicals [2]		
	Plants	Short tons	Value	Plants	Short tons	Value	Plants	Short tons	Value
1932	6	3,295	$149,869	3	3,955	$240,843	5	623	$126,836
1933	4	3,810	181,857	(3)	(3)	(3)	9	5,539	356,970
1934	4	4,706	245,315	(3)	(3)	(3)	7	7,084	601,346
1935	[4] 3	7,329	357,585	(3)	(3)	(3)	5	7,520	642,576
1936	3	11,347	515,624	(3)	(3)	(3)	7	8,893	698,942

[2] Figures cover chemicals as follows, in order of value: 1932: Oxide, binoxide, sulphide, and hydroxide; 1933: Chloride, sulphide, binoxide, and hydroxide; 1934 and 1935: Chloride, binoxide, sulphide, and hydroxide; 1936: Chloride, binoxide, sulphide, hydroxide, and oxide.
[3] Included under "Other barium chemicals."
[4] Revised figure.

Lithopone sold or used by producers, 1934–36, by consuming industries

Industry	1934		1935		1936	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Paints, enamels, and lacquers	114,472	78.6	124,615	78.1	122,461	77.3
Floor coverings and textiles	14,811	10.2	19,440	12.2	23,085	14.6
Rubber	4,596	3.2	4,435	2.8	4,908	3.1
Other	11,686	8.0	10,996	6.9	7,865	5.0
	145,565	100.0	159,486	100.0	158,319	100.0

Prices.—Prices for ground barite and ground witherite were the same in 1936 as in 1935. The quoted price of ground barite, $23 per short ton f. o. b. St. Louis, has not changed for several years. Lithopone price quotations had a slightly greater range in 1936 than in 1935, as the lower limits were slightly below those of 1935 and the upper limits were the same. Quotations for barium chemicals changed little. Prices for barium carbonate, barium chloride, barium dioxide, and blanc fixe were the same in both years. Prices for barium chlorate ranged from 15½ to 17½ cents a pound in 1936 compared with 14 to 17½ cents in 1935. Quotations for barium hydrate were 5¼ to 6 cents in 1936; only a slight deviation from 5½ to 6 cents in 1935. Barium nitrate prices in 1936 ranged between 7 and 8¼ cents compared with a quotation of 8¼ cents in 1935.

Range of quotations on barium products, 1934–36 [1]

	1934	1935	1936
Ground barite, barrel, St. Louis..........short tons..	$23.00	$23.00	$23.00
Ground witherite, works [2]..........do....	42.00 –45.00	42.00 –45.00	42.00 –45.00
Lithopone, January–November, 400-pound barrel, l. c. l..........pound..	.04¾– .05	----------	----------
Domestic, ordinary, delivered, bags..........do....	[3] .04½– .04¾	.04½– .04¾	.04¼– .04¾
Barrels..........do....	[3] .04¾– .05	.04¾– .05	.04½– .05
High strength, bags..........do....	[3] .06 – .06¼	.06 – .06¼	.05¾– .06¼
High strength, barrels..........do....	[3] .06¼– .06½	.06¼– .06½	.06 – .06½
Titanated, bags..........do....	[3] .06 – .06¼	.06 – .06¼	.05¾– .06¼
Titanated, barrels..........do....	[3] .06¼– .06½	.06¼– .06½	.06 – .06½
Barium carbonate, 200-pound bags..........short tons..	56.50 –61.00	56.50 –61.00	56.50 –61.00
Barium chlorate, 112-pound kegs, New York..pound..	.14 – .16	.14 – .17½	.15½– .17½
Barium chloride, 600-pound barrel, works..short tons..	72.00 –74.00	72.00 –74.00	72.00 –74.00
Barium dioxide (binoxide or peroxide), 88 percent, 690-pound drums..........pound..	.11 – .13	.11 – .12	.11 – .12
Barium hydrate, 500-pound barrel..........do....	.04¾– .06	.05½– .06	.05¼– .06
Barium nitrate, 700-pound casks..........do....	.07¼– .08¼	.08¼	.07 – .08¼
Barium sulphate, precipitated (blanc fixe), 400-pound barrel..........short ton..	[4] 42.50 –75.00	[4] 42.50 –70.00	[4] 42.50–70.00

[1] Chemical Industries (formerly Chemical Markets), New York (monthly); Metal and Mineral Markets New York (weekly).
[2] 90 percent through 300-mesh.
[3] Quotations for December only.
[4] Lowest price for pulp grade, highest for high-grade precipitated.

Foreign trade.—Imports of various barium compounds during the past 5 years are given in the following table:

Barium compounds imported for consumption in the United States, 1932–36

[Value at port of shipment]

Year	Ground barite		Lithopone		Barium dioxide		Blanc fixe (precipitated barium sulphate)		Artificial barium carbonate (chemically precipitated)	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1932......	1,594	$16,757	4,724	$271,678	(1)	$27	656	$24,100	303	$5,630
1933......	2,632	30,492	5,596	313,341	1	82	245	12,093	49	1,632
1934......	1,663	16,916	3,927	219,752	(2)	58	459	26,156	--------	--------
1935......	3,354	28,766	4,603	256,731	(3)	72	141	9,403	11	631
1936......	2,873	28,397	4,780	273,571	(4)	223	123	6,971	30	889

Year	Witherite, crude, unground		Barium chloride		Barium nitrate		Barium hydroxide		Barium oxide		Barium compounds (n. e. s.)	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1932......	2,680	$34,336	39	$1,208	330	$21,421	235	$10,494	(5)	$11	(6)	(6)
1933......	2,949	47,324	6	526	359	31,140	281	15,542	110	9,416	8	$3,224
1934......	2,358	43,808	107	4,808	454	44,884	287	17,548	(7)	66	4	1,266
1935......	2,634	48,551	392	17,170	258	24,412	271	16,987	(8)	26	8	1,852
1936......	2,464	44,475	243	10,355	185	19,107	370	25,423	(9)	155	8	2,231

[1] 328 pounds.
[2] 370 pounds.
[3] 450 pounds.
[4] 1,392 pounds.
[5] 22 pounds.
[6] Not separately recorded prior to 1933.
[7] 132 pounds.
[8] 33 pounds.
[9] 287 pounds.

Exports of lithopone in 1936 increased to 2,538 short tons valued at $229,942, the largest quantity and value of any year since 1932. The unit value of exports of lithopone during 1936 was $90.60, a slight decrease from the $93.43 unit value of exports in 1935 but still above the low point of $83.09 in 1934.

Lithopone exported from the United States, 1932–36

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1932	3,212	$270,195	$84.12	1935	2,372	$221,611	$93.43
1933	1,186	107,923	91.00	1936	2,538	229,942	90.60
1934	2,401	199,508	83.09				

BIBLIOGRAPHY

Coulson, A. L. Barytes in the Ceded Districts of the Madras Presidency: With Notes on Its Occurrence in Other Parts of India. Mem. Geol. Survey India, vol. 64, no. 1, 1933, 142 pp.

Edmundson, R. S. Barite Deposits of Virginia. Am. Inst. Min. and Met. Eng., Tech. Pub. 725, 1936, 17 pp.

Hardy, Charles. Barium and Strontium. Min. Ind., vol. 44, 1935, pp. 54–57.

Hopson, R. F. Barite Mining in Southern Missouri. Explosives Eng., vol. 14, no. 4, April 1936, pp. 107, 113.

Mills, H. Characteristics of Lithopone and Zinc Sulphide Pigments for Paint Manufacture. Chem. Ind., vol. 38, no. 5, May 1936, pp. 481–482.

Ohl, Fritz. Lithopone in the Synthetic Plastics Industry. Nitrocellulose, vol. 7, 1936, pp. 40–41, 62–63.

Riley, J. J. Barium as a Chemical Raw Material. Chem. Ind., vol. 39, no. 1, July 1936, pp. 13–18.

Siotis, G. J. The Barytes Deposits of Greece. Sands, Clays, and Minerals, vol. 3, no. 1, November 1936, pp. 43–46.

Talmadge, S. B., and Wootton, T. P. Non-metallic Mineral Resources of New Mexico. N. Mex. School of Mines and Mineral Resources, Bull. 12, 1937, Barite, pp. 49–52.

POTASH

By J. H. Hedges

SUMMARY OUTLINE

The slackened demand for new potash in world markets apparent in 1936 probably reflected absorption of stocks accumulated by consumers and speculators in 1935 at the bargain prices resulting from the German-Spanish potash war rather than an actual shrinkage in consumption of potash salts. Reports of fertilizer sales indicate an upward trend that would normally produce a parallel movement in the potash trade.

In the United States the rapidly rising curve that in 1935 pictured a 57-percent increase in producers' and importers' sales for domestic consumption, to reach an all-time high of 420,000 short tons, turned downward in 1936 to 397,000 tons. Crop restrictions, drought, and speculative resales each contributed to this result in undetermined degree. Stocks bought at bargain prices in 1935 and sold or distributed at the higher levels prevailing in 1936 were recorded in Government statistics as sales for consumption in the first instance and were unreported on their later reappearance through resale or otherwise for actual use. Analysis of export figures indicates that about 40,000 tons of this material were disposed of through export channels in 1936, but no information is available to indicate how much found its way into domestic use. Estimates of consumption in 1935 and 1936 are obviously distorted by lack of information regarding stocks in the hands of consumers and speculators that normally have little significance.

Notwithstanding a slight drop in domestic sales the value at the plant of all material sold increased $1,975,000, evidencing the more favorable price levels that prevailed throughout 1936. The total value of imports dropped only about 2 percent, although the tonnage in terms of K_2O fell off 12 percent. The industry appears now to have emerged from the aftermath of the 1934–35 price war, and the recent course of the market indicates that stocks accumulated at that time have been nearly if not completely liquidated. The trend of fertilizer sales in the early months of 1937 indicates a continuation of the upward movement in potash consumption.

The growing use of high-analysis salts was strikingly in evidence during the year. Muriate averaging 61 percent K_2O constituted

153336—37——88

94 percent of domestic sales, and high-grade salts averaging 56 percent made up 63 percent of imports. The use of more concentrated fertilizers effects a large saving in freight on inert materials, and the farmers are learning to apply them without injury to crops. However, domestic refiners still find it expedient to dilute part of their high-purity products to supply the slowly diminishing demand for lower-grade material. Continued educational efforts eventually may eliminate the necessity for this uneconomic practice.

Except for better prices the domestic picture was little changed from that in 1935. The plant of the American Potash & Chemical Corporation at Trona, Calif., extracting potash and other salts from the brines of Searles Lake, and the mines of the United States Potash Co. and the Potash Co. of America at Carlsbad, N. Mex., together supplied over 98 percent of American output. A few thousand tons were derived from distillery waste and cement flue dust, and insignificant amounts were contributed by cotton-boll ashes and untreated alunite. Reports that small quantities of potash were made from brines of the Salduro marsh in Utah could not be substantiated. Plants of the three principal producers were operated at full capacity, turning out high-purity muriate in quantity slightly in excess of sales.

Interruption of Spanish shipments at about midyear, following the outbreak of civil war, had little or no effect on world markets, as the Spanish quota was supplied by German members of the International Cartel. The prospect for 1937 is less assuring in this respect. Seizure and operation of the mines by the Spanish Government appear inevitable, if not already an accomplished fact. The natural sequence would be to dump the output abroad at any price obtainable to procure foreign exchange for purchase of war materials. Neutrality agreements and European political alinements offer some obstacles to this procedure.

The International Potash Cartel now includes all important producing countries except the United States and U. S. S. R. (Russia), although the Spanish members no longer control their properties. The addition of Palestine to the cartel group did not materially change relations previously adjusted by informal arrangement. U. S. S. R. now displays little interest in foreign markets, and her own need for potash so far exceeds her present capacity to produce that the home market may be expected to occupy her attention for some time to come.

Salient statistics of the domestic potash industry for 1935 and 1936 are summarized in the following table:

Salient statistics of the potash (crude and refined potash materials) industry in the United States, 1935–36

	1935	1936
Production (potassium salts) short tons	357,974	431,470
Sales (potassium salts):		
Short tons	406,922	396,690
Value at plant	$4,993,481	$6,969,190
Average per ton	$12.27	$17.57
Imports (crude and refined):		
Short tons	603,595	493,711
Value	$12,512,711	$12,316,956
Exports:		
Fertilizer material:		
Short tons	75,983	103,031
Value	$1,992,062	$3,049,822
Other:		
Short tons	3,641	2,333
Value	$637,473	$487,347

PRICES

Following the usual custom, base prices of 1935 schedules without discount carried over to April 30, 1936, the end of the 1935–36 season. Muriate was quoted at 45 cents per unit of K_2O, 30-percent manure salts at 48 cents per unit, 20-percent kainite at 55 cents per unit, sulphate at \$33.75 per ton, and sulphate of potash-magnesia at \$22.25 per ton. New schedules issued in April continued these prices through May and June. In the latter part of June new lists appeared raising base prices to 50 cents per unit for muriate, 55 cents per unit for 30-percent manure salts, \$12.00 per ton for 20-percent kainite, \$36.25 for sulphate and \$24.75 for sulphate of potash-magnesia. Seasonal discounts offered were 10 percent to July 15, 5 percent to September 30, and 2 percent to November 30. Early in July the 10-percent discount was raised to 12 percent and extended to include July 18. After November 30 prices were net list, guaranteed to and including June 30, 1937. All quotations are c. i. f. customary United States Atlantic, Gulf, and Pacific ports.

The following table, compiled by the American Potash Institute, shows average net prices for the years 1926 to 1936, inclusive, and month-by-month averages for 1936. These figures are averages of published quotations, not weighted for tonnage, the bulk of which is sold during the discount period.

Net prices of potash salts, 1926–36, per short ton

	Domestic muriate of potash, bulk basis, 50-percent K_2O	Imported muriate of potash, bulk basis, 50-percent K_2O	Sulphate of potash, 90-percent K_2SO_4, in bags	Sulphate of potash-magnesia, 48-percent K_2SO_4, in bags	Manure salts, bulk basis, 30-percent K_2O	High-grade kainite, bulk basis, 20-percent K_2O
1926	\$29.20	\$29.81	\$41.01	\$23.58	\$16.12	\$10.48
1927	31.33	32.28	44.34	25.55	17.58	11.63
1928	32.02	33.43	45.92	26.46	18.20	12.04
1929	31.61	33.62	46.77	26.59	18.31	12.09
1930	32.28	34.05	46.72	26.92	18.54	12.25
1931	32.33	34.05	46.72	26.92	18.54	12.25
1932	31.86	34.02	46.21	26.90	18.53	11.83
1933	31.49	33.11	44.71	26.17	18.03	11.30
1934	23.22	24.20	37.85	23.34	14.50	9.41
1935	20.77	20.77	32.84	21.47	13.36	9.81
1936	23.18	23.18	33.99	22.94	15.15	11.19
MONTHLY AVERAGE PRICES, 1936						
January	\$22.50	\$22.50	\$33.75	\$22.25	\$14.40	\$11.00
February	22.50	22.50	33.75	22.25	14.40	11.00
March	22.50	22.50	33.75	22.25	14.40	11.00
April	22.50	22.50	33.75	22.25	14.40	11.00
May	22.00	22.00	31.90	21.78	14.52	10.50
June	22.00	22.00	31.90	21.78	14.52	10.50
July	22.68	22.68	32.88	22.45	14.97	10.88
August	23.75	23.75	34.44	23.51	15.67	11.40
September	23.75	23.75	34.44	23.51	15.67	11.40
October	24.50	24.50	35.52	24.25	16.17	11.70
November	24.50	24.50	35.52	24.25	16.17	11.70
December	25.00	25.00	36.25	24.75	16.50	12.00

Price schedules for the season July 1, 1937, to May 31, 1938, issued in May 1937, again raise the price. Muriate is quoted at 53½ cents per unit of K_2O, 30-percent manure salt at 58½ cents per unit, 20-percent kainite at \$12.75 per ton, and sulphate of potash-magnesia at \$25.75 per ton. Discounts are 12 percent to June 30, 5 percent to September 30, and net thereafter.

CONSUMPTION AND USES

On the assumption that exports not traceable to domestic origin represented resales of previously accumulated stocks in the hands of consumers or speculators, primary sales for domestic consumption totaled 826,511 short tons equivalent to 396,466 tons of K_2O compared with 930,000 tons equivalent to 420,000 tons of K_2O in 1935. Total domestic consumption was more by an undeterminable amount than these figures indicate, since absorption of accumulated stocks in the hands of fertilizer manufacturers, normally of little significance, were important in 1936 trade. Potash consumption in recent years has been running ahead of fertilizer sales because of the growing tendency to increase the potash ratio in mixed fertilizers; 1936 fertilizer sales of 6,815,000 tons were 10 percent above 1935.

The average potash content of all material sold for domestic consumption in 1936 was 48 percent compared with 45 percent in 1935, showing the continuing shift to high-purity salt. The total of imports and sales of domestic products was 890,401 short tons of material containing 434,576 tons of potash (K_2O) valued at $19,286,146 compared with 1,010,517 tons of material containing 466,231 tons of potash valued at $17,506,192 in 1935. Domestic producers supplied 45 percent of the gross tonnage containing 51 percent of the potash in 1936 compared with 40 percent of the gross containing 48 percent of the potash in 1935. In terms of K_2O, domestic sales decreased about 1 percent in amount, but increased nearly 40 percent in value. Imports decreased 12 percent in amount and 2 percent in value. About 8 percent of the total potash was absorbed by the chemical industries, and 92 percent was sold for fertilizer.

In the following table the quantity and source of potash materials sold by producers and importers for agricultural use and for use in the chemical industries are shown. The total given is primary supply only, exclusive of resales, and the exports deducted to indicate domestic consumption are likewise exclusive of resale. There was little inducement for speculative purchases in 1936, and it is assumed that virtually all resales during that year came from stocks accumulated at the low point in 1935 that could be disposed of profitably on the 1936 market. About 40,000 tons of exports were derived from this source. This break-down was made possible by information, not hitherto available, supplied by the American Potash Institute.

Primary supply of potash salts in the United States in 1936, in short tons

	Bulk salts	K_2O equivalent
For agricultural use:		
Domestic sales	370,539	206,396
Imports	452,194	195,645
Total agricultural	822,733	402,041
For chemical use:		
Domestic sales	26,151	16,414
Imports:		
Muriate	1,450	871
Sulphate	1,754	888
Chemical salts	38,313	14,362
Total chemical	67,668	32,535
Total primary supply	890,401	434,576
Exports from primary sources	63,890	38,110
Domestic consumption	826,511	396,466

PRODUCTION AND SALES

Domestic production of merchantable potash salts increased 21 percent to a new high of 431,470 short tons. The average grade of these products was 57 percent K_2O, and the total potash 247,340 tons, an increase of 28 percent over the 1935 output. Production exceeded sales by 34,780 gross tons, an excess of 9 percent. Sales decreased 10,232 tons, equivalent to 1,911 tons of potash, but the value at the plant of all products sold increased nearly 40 percent.

The total tonnage of potash materials, as reported by producers, is made up of both crude and refined salts containing varying quantities of K_2O; to avoid duplication, however, for refined material only the final weight is included rather than the larger tonnage of crude required in its production. Hence, the domestic production of crude salts is larger than is shown in the following table, although the figure truly represents the operators' output of both crude and refined salts without duplication. To reduce different grades of salts to a common denominator, the production and sales also are calculated in terms of K_2O content. The resulting figures are reliable indicators of trends in the industry and are generally used in the trade because potash commonly is sold on the K_2O basis.

Production and sales by States and by sources cannot be given without disclosing individual output. Production and sales of potassium salts and stocks in the hands of producers for the past 5 years are summarized in the following table:

Potassium salts produced, sold, and in producers' stocks in the United States, 1932–36

Year	Production			Sales				Producers' stocks		
	Number of operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)	Number of operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)	Value f. o. b. plant	Number of operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)
1932	5	143, 120	61, 990	5	121, 390	55, 620	$2, 102, 590	3	41, 000	28, 000
1933	4	333, 110	143, 378	4	325, 481	139, 067	5, 296, 793	4	46, 943	20, 891
1934	8	275, 732	144, 342	8	224, 875	114, 122	2, 813, 218	4	95, 844	50, 066
1935	10	357, 974	192, 793	10	406, 922	224, 721	4, 993, 481	6	47, 710	18, 060
1936	7	431, 470	247, 340	7	396, 690	222, 810	6, 969, 190	5	73, 139	34, 000

GOVERNMENT ACTIVITIES

Two more patents were issued during the year covering processes developed in Bureau of Mines laboratories for the recovery of potassium salts from minerals. All patents growing out of the Bureau's work on potash recovery have been assigned to the United States.

The policy adopted in 1935 of withholding issuance of potash-prospecting permits in New Mexico to avoid overdevelopment was continued during 1936. No new permits were issued, and all permits previously issued have now expired by limitation. Three leases were applied for by permittees who had complied with the necessary requirements.

Pursuant to Senate Resolution 274, 74th Congress, 2d Session, a subcommittee of the Committee on Public Lands and Surveys undertook an investigation of all phases of the potash industry. Hearings were held, and the organization of the industry was studied. The

resolution instructed the committee to report at the next session of Congress. However, the investigation has not been completed, and it is anticipated that an interim report will be submitted and authority sought to continue the investigation another year.

The Bureau of Chemistry and Soils of the Department of Agriculture continued the study of methods of preparing suitable potash fertilizer salts from various raw materials. Reed and Clark[1] presented a paper at a meeting of the American Chemical Society describing a method of making potassium nitrate from potassium chloride and nitrogen peroxide. Potassium nitrate contains two important plant food elements and has chemical and physical properties that make its use for fertilizer advantageous, but such use has been limited by the cost of manufacture. Interest has been revived by the advent of low-cost ammonia, a possible source of nitrogen for potassium nitrate.

REVIEW BY STATES

California.—The American Potash & Chemical Corporation, 70 Pine Street, New York, operated its refinery at Trona, Calif., at near capacity throughout the year. Brines from Searles Lake are treated in this modern plant to produce muriate of potash, borax, soda ash, and salt cake. Although other chemical plants are extracting various salts from brines in California, this company is the only producer of potash in the State.

Maryland.—Potash as a byproduct of cement manufacture was recovered from cement-kiln dust by the North American Cement Corporation at its Hagerstown plant. This is the only cement plant in the United States now recovering potash, although during the World War, when potash commanded fabulous prices and was sought from every conceivable source, a number of plants processed the flue dust to extract the potash. The raw material fed to cement kilns may contain 1 percent or more potash.

At Baltimore, potash was recovered from molasses waste at the alcohol plant of the United States Industrial Chemical Co.

New Mexico.—Nearly 600,000 tons of potash ore were mined during 1936 by the two companies operating in the Carlsbad district. Equipment of the mines is ample to handle at least double the tonnage now hoisted. Mechanical equipment underground includes undercutters, electric auger drills, mechanical loaders, electric haulage, and automatic skip loaders. The ore is a mechanical mixture of sylvite (KCl) and halite (NaCl), with insignificant amounts of other impurities.

The refinery of the United States Potash Co. is of the conventional type in which the salts are separated by solution and fractional crystallization, yielding a product of white granular muriate of potash that is better than 99 percent KCl. Operating improvements have stepped up the output of this plant to around 500 tons of muriate a day, about 25 percent above its rated capacity. Increased warehouse facilities add flexibility of operation.

In November the Potash Co. of American completed its No. 2 shaft that will be used primarily for ventilation. The shaft is equipped with a reversible fan of 150,000 c. f. m. capacity that will be operated normally to exhaust air from the mine. At this property, prepara-

[1] Reed, Donald L., and Clark, K. G., Potassium Nitrate from Potassium Chloride and Nitrogen Peroxide: Ind. and Eng. Chem., vol. 29, 1937, p. 333.

tion of high-grade muriate is accomplished by a soap-flotation process in which halite (NaCl) is floated and sylvite (KCl) depressed. The sylvite concentrate, although 96 to 99 percent pure, retains the characteristic red color of the ore. Operation of this plant started in October 1935. It is now being enlarged to double its capacity and is expected to be ready late in 1937 to turn out 400 tons of muriate a day.

The Union Potash & Chemical Co. was formed in January 1936 to consolidate the interests of the Texas Potash Co., the Independent Potash & Chemical Co., the New Mexico Potash Co., and the Carlsbad Potash Co., in a number of prospecting permits that had been explored by drilling. The permits have now expired by limitation, but the company has filed application for three leases of 2,560 acres each covering areas shown by the core tests to contain commercial beds of potash salts. Although the leases had not received the formal approval of the Secretary of the Interior by the early part of 1937, permission was given to continue operations, and a shaft was started in September 1936 at a point about 6 miles directly south of the United States Potash Co. mine. Work was soon stopped but was resumed in February 1937 and in May the shaft was reported to have reached a depth of 218 feet, of which 213 feet had been concreted. Water was encountered at this point, and preparations for sealing it off from the shaft were under way. Core tests indicate a bed of good-grade ore of minable thickness at a depth of about 900 feet. Unlike the other mines in the district, the ore is expected to be a mixture of langbeinite and sylvite, and plans of the company are said include the manufacture of sulphate. It is understood the International Agricultural Corporation, 61 Broadway, New York, has acquired an interest in the property in return for financing development.

All prospecting permits have now expired by limitation, and no new permits or leases were granted during the year.

The New Mexico business privilege tax limited to 1 year enacted in 1934 was reenacted as permanent legislation in 1935 (Chap. 73, Laws of 1935). This law imposes on potash producers a tax of 2 percent on the gross receipts of crude potash sold and ½ of 1 percent on the gross receipts of refined products sold. In addition, the severance-tax law enacted in the spring of 1937 levies a tax of 1 percent on the value of all potash products "computed as of the time when and the place where the same have been severed or taken from the soil immediately after such severance." Both taxes are assessed on gross value after deducting royalties or rentals paid the United States of America or the State of New Mexico.

Utah.—According to a recent announcement, Western Mineral Products, Inc., San Fernando, Calif., will utilize the plant of the Soil-Tone Fertilizer Co. to manufacture fertilizer products from Marysvale (Utah) alunite. The alunite will be calcined, ground, and bagged at the San Fernando plant.

FOREIGN TRADE [2]

Imports.—Imports of potash materials for consumption in the United States decreased 109,844 short tons (18 percent) to 493,711 tons. In terms of K_2O, the decrease was only 12 percent, reflecting

[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

the larger proportion of high-grade salts. The average grade was 43 percent equivalent to 211,766 tons of K_2O compared with an average of 40 percent in 1935. Fertilizer salts comprised 93 percent of the total potash imported, 7 percent being destined for chemical and other industrial uses.

The quantity, average grade, and total declared value of the various potash salts imported in 1935 and 1936, classified by uses, and the approximate K_2O equivalent of imports for the past 5 years are shown in the following tables:

Potash materials imported for consumption in the United States, 1935-36

Material	Approximate equivalent as potash (K_2O) (percent)	1935				1936			
		Short tons	Approximate equivalent as potash (K_2O)		Value	Short tons	Approximate equivalent as potash (K_2O)		Value
			Short tons	Percent of total			Short tons	Percent of total	
Used chiefly in fertilizers:									
Kainite	14.0	1,845	258	0.1	$11,315	1,616	226	0.1	$10,908
	20.0	81,043	16,209	6.7	578,714	57,676	11,535	5.5	517,638
Manure salts	30.0	95,563	28,669	11.9	1,054,181				
	31.4					39,053	12,263	5.8	475,049
Muriate (chloride)	52.0	262,370	136,432	56.5	4,743,913				
	56.4					235,959	133,081	62.8	5,193,634
Nitrate (saltpeter) (Chilean)	14.0	31,631	4,428	1.8	689,564	47,630	6,668	3.1	1,007,034
Potash-magnesia sulphate	27.0	25,876	6,987	2.9	515,281	13,605	3,673	1.7	276,788
Sulphate	50.0	70,819	35,410	14.6	2,014,626	59,581	29,791	14.1	1,812,793
Other potash fertilizer material [1]	60.0	272	163	.1	1,849	278	167	.1	2,206
Total fertilizer		569,419	228,556	94.6	9,609,443	455,398	197,404	93.2	9,296,050
Used chiefly in chemical industries:									
Bicarbonate	46.0	219	101		35,529	146	67		23,068
Bitartrate (argols)	20.0	8,184	1,637		902,541	8,403	1,681		910,620
Bitartrate (cream of tartar)	25.0	(2)	(2)		8	95	24		18,658
Bromide	39.6	5	2		2,904	18	7		13,114
Carbonate, crude	61.0								
Carbonate, crude or black salts	50.0	2,063	1,258		231,551	1,397	852		150,806
Carbonate, refined	67.0								
Caustic	80.0	1,713	1,370		226,165	1,546	1,238		209,505
Chlorate and perchlorate	36.0	7,159	2,577	5.4	752,007	7,014	2,525	6.8	775,810
Chromate and bichromate	40.0					(2)	(2)		469
Cyanide	70.0	49	34		38,780	50	35		40,803
Ferricyanide (red prussiate)	42.0	81	34		38,610	92	39		44,482
Ferrocyanide (yellow prussiate)	44.0	17	7		4,763	43	19		10,150
Iodide	28.0	(2)	(2)		581	(2)	(2)		46
Nitrate (saltpeter), crude	40.0	13,626	5,450		554,586	18,311	7,324		694,200
Nitrate (saltpeter), refined	46.0	748	344		56,910	878	404		66,606
Permanganate	29.0	74	21		15,577	63	18		13,378
All other	50.0	238	119		42,756	257	129		49,191
Total chemical		34,176	12,954	5.4	2,903,268	38,313	14,362	6.8	3,020,906
Grand total		603,595	241,510	100.0	12,512,711	493,711	211,766	100.0	12,316,956

[1] Chiefly wood ashes from Canada.
[2] Less than 1 ton.

Approximate equivalent as potash (K_2O) of potash-bearing materials imported for consumption in the United States, 1932-36, in short tons

1932	113,505	1935	241,510
1933	171,854	1936	211,766
1934	171,955		

In the following table imports of the various salts from all countries making shipments to the United States are shown. Fertilizer salts imported from Belgium, Canada, and Netherlands represent transshipments of material originating largely in Germany or France.

Potash materials imported into the United States in 1936, in short tons

[Figures in parentheses in column headings indicate in percent approximate equivalent as potash (K_2O)]

Country	Muriate (chloride) (56.4)	Sulphate (50)	Potash-magnesia sulphate (27)	Manure salts (31.4)	Kainite		Bitartrate	
					(14)	(20)	Argols or wine lees (20)	Cream of tartar (25)
Algeria							224	
Argentina							221	
Belgium	9,938	7,536		2,365		5,607		
Canada	7,803	157	8				6	
Chile							37	
China								
Czechoslovakia								
France	5,692	1,536		226		1,076	845	[1]
Germany	117,303	37,389	13,141	21,567	1,023	29,691		
Hong Kong								
Italy							6,501	95
Japan		661						
Lithuania					201			
Netherlands	83,617	12,302	456	14,895	392	21,302		
Portugal							536	
Spain	11,606							
Sweden								
Switzerland								
Tunisia							33	
U. S. S. R. (Russia)								
United Kingdom								
	235,959	59,581	13,605	39,053	1,616	57,676	8,403	95
Approximate equivalent as potash (K_2O)	133,081	29,791	3,673	12,263	226	11,535	1,681	24

Country	Caustic (80)	Carbonate (61)	Cyanide (70)	Nitrate (saltpeter), crude (14 and 40) [2]	Chlorate and perchlorate (36)	All other (48)	Total	
							Short tons	Value
Algeria							224	$19,951
Argentina							221	14,325
Belgium					[1]		25,446	530,262
Canada				874	3	274	9,125	235,820
Chile				47,630	20		47,687	1,013,909
China		1				2	3	392
Czechoslovakia		12				59	71	12,911
France	[1]				868	[1]	10,243	347,943
Germany	1,403	1,249	50	17,437	5,039	1,352	246,644	6,314,850
Hong Kong		7				2	9	956
Italy						1	6,597	734,750
Japan					221	19	901	44,915
Lithuania							201	500
Netherlands		114				47	133,125	2,573,222
Portugal							536	49,777
Spain							11,606	261,834
Sweden	143	1			168		312	69,819
Switzerland					695	1	696	77,079
Tunisia							33	2,933
U. S. S. R. (Russia)					[1]		[1]	5
United Kingdom		13				18	31	10,803
	1,546	1,397	50	65,941	7,014	1,775	493,711	12,316,956
Approximate equivalent as potash (K_2O)	1,238	852	35	13,992	2,525	850	211,766	--------

[1] Less than 1 ton.
[2] Nitrate from Chile calculated at 14 percent K_2O, other countries 40 percent.

Exports.—Exports of fertilizer salts again registered a notable increase. However, this was due entirely to speculative resales and does not represent enlarged export business of domestic producers. In fact fertilizer exports from primary sources decreased from 68,922 short tons of salts equivalent to 41,283 tons of K_2O in 1935 to 61,557 tons equivalent to 37,235 tons of K_2O in 1936. Of recorded exports 41,474 tons containing approximately 24,844 tons of K_2O were drawn from stocks that were doubtless bought for speculative purposes at the attractive low prices prevailing from May 1934 to July 1935 and profitably disposed of at the higher price levels of 1936. The stabilized market of 1936 offered little inducement for speculative buying, and there is no evidence of significant transactions of that nature. Japan and Canada continue to be our best customers for domestic products, although exports to Belgium exceeded those to Canada in 1936. It is obvious that exports of potash fertilizer salts to many of the countries listed in the following table would be improbable, except under extraordinary circumstances.

The chemical salts exported include cream of tartar, potassium bromide, potassium chlorate, potassium citrate, potassium iodide, and saltpeter. Quantities are small, but per-ton values are high.

Potash fertilizer material exported from the United States, 1935–36, by destinations

Destination	1935		1936	
	Short tons	Value	Short tons	Value
Argentina	38	$1,238		
Australia			3	$89
Barbados			288	9,342
Belgium	2,794	74,051	16,488	425,284
Canada	13,751	304,339	10,549	272,713
China	1,145	31,976		
Colombia	3	100	4	213
Cuba	777	17,660	897	24,561
Dominican Republic	6	180		
Finland	200	6,544	888	26,134
France			838	27,094
Germany	587	16,862	677	20,610
Guatemala	17	1,513	21	1,179
Haiti	1	41	29	826
Honduras	398	10,675	161	4,681
India, British			34	1,219
Italy	2,480	37,742	1,995	60,786
Jamaica	1	80		
Japan	50,176	1,387,615	60,665	1,888,509
Mozambique			85	2,950
Netherlands	560	18,125	1,494	47,283
New Zealand	2	139		
Nicaragua	2	65	1	59
Norway			1,936	54,633
Oceania, French			(1)	3
Panama			3	84
Philippine Islands	616	12,425	560	17,900
Salvador			1	95
Sweden	2,369	68,466	3,835	112,892
Trinidad and Tobago			6	571
Union of South Africa			1,213	39,727
United Kingdom			151	4,631
Venezuela	13	723	(1)	23
West Indies ("Other British")	47	1,503	209	5,731
	75,983	1,992,062	103,031	3,049,822

[1] Less than 1 ton.

Potassium salts (not fertilizer) exported from the United States, 1932–36

Year	Short tons	Value	Year	Short tons	Value
1932	887	$241,179	1935	3,641	$637,473
1933	1,275	301,596	1936	2,333	487,347
1934	2,121	466,929			

WORLD PRODUCTION

There are so many gaps in official figures for production in 1936 that only an approximation of world output is possible. In the following table showing metric tons of K_2O in marketable salts produced, 1936 output of Soviet Russia, Spain, and Palestine are estimated. An increase of about 5 percent in the world total is indicated.

Approximate world production of marketable potash salts, 1935–36

Country	1935		1936	
	Metric tons K_2O	Percent of total	Metric tons K_2O	Percent of total
Germany	1,396,000	61.2	1,435,000	59.7
France	347,300	15.2	365,200	15.2
United States	174,897	7.7	224,386	9.4
U. S. S. R. (Russia)	150,000	6.6	200,000	8.3
Poland	71,539	3.1	85,000	3.6
Spain	121,372	5.3	75,000	3.1
Palestine	10,851	.5	12,500	.5
Other countries	10,000	.4	5,000	.2
	2,281,959	100.0	2,402,086	100.0

Available official figures of world production from 1932 to 1936 are shown in the following table:

World production of potash minerals and equivalent K_2O, 1932–36, in metric tons

[Compiled by R. B. Miller]

Country and mineral [1]	1932		1933		1934		1935		1936	
	Output	Equivalent K_2O	Output	Equivalent K_2O	Output	Equivalent K_2O	Output	Equivalent K_2O	Output	Equivalent K_2O
China, potassium carbonate [2]	15	(3)	22	(3)	57	(3)	38	(3)	(3)	(3)
Chosen, alunite	16,320	(3)	27,220	(3)	56,330	(3)	81,510	(3)	(3)	(3)
Egypt, crude potassium salts	8	(3)	4	(3)					(3)	(3)
Eritrea, mellahite [4]			3,600	720	4,200	840	(3)	(3)	(3)	(3)
France (Alsace), crude potassium salts	1,920,000	[5] 326,500	1,890,600	[5] 332,000	2,054,400	[5] 378,900	2,027,200	[5] 347,300	2,099,400	365,200
Germany, crude potassium salts:										
Carnallite [6]	635,940	61,245	642,445	65,285	829,669	81,020	1,371,604	1,599,134	(3)	(3)
Kainite, sylvanite, and hartsalz	5,779,591	810,109	6,720,326	960,829	8,787,010	1,248,408	10,300,905		(3)	(3)
India (British), nitrate of potash [7]	9,100	4,400	10,000	4,900	9,100	4,400	9,300	4,500	(3)	(3)
Italy:										
Alunite	700	84	534	64	1,605	193	2,092	406	(3)	(3)
Leucite rock	44,000	3,520							(3)	(3)
Palestine, crude potassium salts [8]	10,200	5,100	15,000	7,500	14,238	8,982	19,538	10,851	(3)	(3)
Poland, crude potassium salts:										
Kainite	44,692	4,759	62,537	6,979	86,172	10,217	81,593	8,159	89,187	83,935
Sylvite	231,966	52,285	236,608	70,391	213,906	51,337	288,091	63,380	336,317	
Langbeinite					1,470	300	13,914	1,670	8,600	1,032
Spain:										
Alunite							(3)	(3)	(3)	(3)
Crude potassium salts	409,888	54,811	623,941	90,637	872,839	129,687	776,873	121,372	(3)	(3)
Potassic earth	750	(3)	500	(3)	500	(3)	(3)	(3)	(3)	(3)
U. S. S. R. (Russia), crude potassium salts [9]	78,532	(3)	303,094	42,122	1,001,602	139,197	1,319,000	(3)	(3)	(3)
United States, potassium salts	129,836	56,236	302,191	130,070	250,139	130,944	324,747	174,897	391,421	224,382

[1] In addition to countries listed Chile and Iran are reported to produce a small quantity of potash salts, but statistics of production are not available.
[2] Exports.
[3] Data not available.
[4] Extracted from waters of the Red Sea.
[5] Content of merchantable products.
[6] Includes some natural kieserite.
[7] Estimated production (Imperial Institute, London).
[8] Extracted from waters of the Dead Sea.
[9] Produced at Solikamsk potash mines.

FOREIGN DEVELOPMENTS

The following comments on the potash industry in foreign countries are based on information drawn largely from official reports to the Bureau of Mines and the Bureau of Foreign and Domestic Commerce. Acknowledgment is made to the following consular officers and commercial agents: Commercial Attaché Gardner Richardson, Vienna, Austria; Assistant Trade Commissioner Wilson C. Flake, Sydney, Australia; Assistant Trade Commissioner Earle C. Taylor, Paris, France; Consul Edwin A. Plitt, Paris, France; Vice Consul R. Austin Acly, Strasbourg, France; Vice Consul Sydney B. Redecker, Frankfort-on-Main, Germany; Consular Clerk W. S. Jesien, Frankfort-on-Main, Germany; Consul David H. Guffum, Leipzig, Germany; Consul General G. K. Donald, Milan, Italy; Trade Commissioner Paul P. Steintorf, Tokyo, Japan; Assistant Trade Commissioner Carl H. Boehringer, Tokyo, Japan; Vice Consul James Espy, Mexico City, Mexico; Consul General Leland B. Morris, Jerusalem, Palestine, Consul General George Wadsworth; Jerusalem, Palestine; Commercial Attaché George R. Canty, Warsaw, Poland; Consular Clerk M. Pfeiffer, Warsaw, Poland; Vice Consul Charles Will Wright, Warsaw, Poland; Consul Thomas H. Bevan, Warsaw, Poland; Consul Daniel M. Braddock, Barcelona, Spain; Consul Lynn W. Franklin, Barcelona, Spain; Consul E. B. Bower, Stockholm, Sweden.

Australia.—Better prices for wool and wheat resulted in increased fertilizer consumption in 1936 and further expansion of fertilizer sales is anticipated in 1937. During the 1935–36 fertilizer year Australia imported 3,012 tons of potassium sulphate and 7,436 tons of potassium chloride, of which Palestine supplied 700 tons of sulphate and 2,201 tons of chloride.

Austria.—Experimental borings for potash are being carried on at the Hallein mine in Upper Austria. Recent developments are said to offer some encouragement that potash deposits will be found not very far beneath the Hallein salt beds, although the National Geological Association is of the opinion that there are no deposits worth exploiting below the salt beds. If deposits are discovered they could be opened by almost horizontal adits from the valleys.

France.—Total output of 2,099,400 metric tons of potash salts equivalent to 365,200 tons of K_2O in 1936 surpassed by a narrow margin the corrected 1935 figures of 2,027,200 tons of salts and 347,300 tons of K_2O. About two-thirds was supplied by the State mines and one-third by Kali Sainte-Thérèse. Sales totaled 386,000 tons of K_2O, an increase of 40,000 tons from the previous year, but still 106,000 tons behind the record year 1929. In terms of equivalent K_2O, the domestic market absorbed 220,000 tons in 1936 against 155,000 tons in 1935 and 230,000 tons in 1929. Exports dropped 26,000 tons to 166,000 tons. Potash available for export, after supplying the domestic market that must be given priority, was less than the French export quota. The deficiency was made up by other members of the International Cartel. Domestic prices were unchanged in the face of higher costs imposed by labor legislation, but export sales were more profitable following devaluation of the franc. On the whole, the industry enjoyed a prosperous year. Kali Sainte-Thérèse, capitalized at 80,000,000 francs, reported that net profits in 1936 increased 6.8 million to 23,900,000 francs and declared a dividend of 32 percent compared with 22 percent in 1935. The State-

controlled mines likewise have proved very profitable and in the past 12 years have paid 263,000,000 francs in dividends into the State treasury. These mines were acquired by the French Government in 1924 after having been sequestered since 1919. A law regulating their operation that has been before the National Assembly for a number of years finally passed the Senate and was published January 26, 1937. This law provides that the French Government shall remain owner and exploiter of the mines, the profits to be divided between the public Treasury, the three Departments of the Haut-Rhin, the Bas-Rhin, and the Moselle, the former French or allied shareholders whose bonds have not been liquidated, and the agricultural syndicate. The management of these mines is subject to the control of the ministers of Public Works, Agriculture, Commerce, Labor, and Colonies, as well as the Finance Inspection services and the Accounts and Finance Commissions of the Assembly. The law stipulates that all exploiters of potash mines in France, Algeria, and the French colonies shall belong to one common sales agency which will have exclusive sale of their product at prices controlled by the Government. The maximum prices for potash in France and Algeria will be fixed by the Minister of Public Works, in agreement with the Minister of Agriculture for farm use and with the Minister of Commerce for industrial uses. In the French Colonies these maximum prices will be fixed by the Minister of Public Works in agreement with the Minister for the Colonies. The law also provides that in future all new potash deposits in France, Algeria, and the French Colonies shall be reserved for the State.

A decree, effective November 1, 1936, extended to workers in underground potash mines the provisions of the decree of September 25, 1936, limiting working hours in underground coal mines to 38 hours, 40 minutes per week, or 7 hours 45 minutes per day, 5 days a week. Reduction in the hours of labor, increased wages, and paid vacations are expected to result in an increase in the price of potash. However, the workers were not satisfied with these concessions; the trade unions in Alsace immediately demanded a 30-hour week and a stay-in strike broke out in two mines. In February 1937, 10,000 workers in the State mines went out on strike.

A new discovery of seeming importance in the neighborhood of Hettenschlag, Department of the Haut-Rhin, Alsace, was reported during the year. Two bore holes encountered potash at depths of 748 meters and 912 meters, respectively. In the first hole three beds totaled 4.42 meters in thickness and averaged 18.8 percent K_2O. In the second hole also, three beds were found totaling 3.40 meters in thickness and 18 percent K_2O content. The deposit is now estimated to contain about 16,000,000 tons.

A company with a capital of 16 million francs has been formed in Paris to prospect and exploit the potash deposits in the Landes district of southwestern France, formerly held by the Société Minière du Sud-Ouest. It is understood the Government has authorized the State mines to acquire a substantial share in the new enterprise. It is estimated that at least 5 years will be required to develop and equip these properties, by which time it is hoped that consumption of potash will have increased enough to absorb the output of these new mines without disturbing the stability of the domestic market.

Germany.—Consul Sydney B. Redecker, Frankfort-on-Main, reports continued improvement in the German potash industry, though

at a slower pace. The rapid recovery in potash output from the depression low of 1932 slackened in 1936 to an increase of only 39,000 tons of potash in marketable salts, about 3½ percent above the 1935 figure. Although domestic sales expanded around 10 percent, exports fell 1½ percent in bulk and nearly 4 percent in contained K_2O. Notwithstanding this shrinkage in volume, the value of export shipments increased about 16 percent, reflecting higher international prices. A considerable, but undetermined part of 1936 German potash exports was for the account of Spanish producers whose operations were interrupted by the war in Spain. If these shipments later are to be supplied by the Spanish companies the share of 1936 world potash trade for German account was less than German export figures indicate. From the following table of output and sales the notable gains of the past 5 years are apparent. Figures for sales in 1936 are not available but probably approximate those for output used in the table.

Production and sales of potash salts in Germany, 1932–36

Year	Production (thousands of metric tons)				Sales (metric tons K_2O)				
	Salts mined		Marketable salts produced		Domestic		Foreign		Total quantity
	Gross weight	K_2O	Gross weight	K_2O	Quantity	Percent of total	Quantity	Percent of total	
1932	6,416	871	[1] 2,659	787	641,179	75.7	205,821	24.3	847,000
1933	7,363	1,026	3,061	906	716,868	76.4	221,132	23.6	938,000
1934	9,617	1,329	4,173	1,179	858,880	70.4	361,120	29.6	1,220,000
1935	11,673	1,599	4,716	1,396	920,000	69.2	410,000	30.8	1,330,000
1936	11,900	[1] 1,644	[1] 4,848	1,435	[2] 1,040,000	72.5	395,000	27.5	[3] 1,435,000

[1] Estimated.
[2] Production available for domestic consumption.
[3] Total production of K_2O in marketable salts.

There was little change in the official domestic schedule of potash prices which, in 1935, resulted in average prices, delivered at any railroad station in Germany, ranging from 17 marks per metric ton for raw salts (12 to 15 percent K_2O) to 84.8 marks for 50 percent muriate and 113 marks for sulphate. On the other hand, the average export value of raw salts jumped from 29.62 marks per metric ton in 1935 to 38.36 in 1936 and that of processed potash from 57.91 marks in 1935 to 66.42 in 1936. The rise in net profits of the four leading potash companies, controlling four-fifths of the industry, from a total of 9.9 million marks in 1934 to 11.1 million in 1935 is believed to have continued in lesser degree in 1936. A recent decree established a price reduction of 25 percent effective May 16, 1937.

Faced in recent years with growing competition in the foreign potash trade, German potash companies have sought by technical improvements to reduce production costs; markets for byproduct materials (magnesium and sodium salts, borax, and bromine) have been developed further; new interests in the nitrogen and crude petroleum industries have been acquired; and during 1936 large plants have been constructed to manufacture synthetic gasoline and magnesium-metal alloys. Carnallite, a low-grade potsah salt abundantly available in existing mines, supplies the raw material from which magnesium metal is extracted by processes recently perfected. These industries, under-

taken by the larger companies (notably Wintershall A. G., leading world potash producer with 50-percent control of the German potash industry) as adjuncts to their basic potash business, have received great impetus from Germany's struggle to attain national self-sufficiency.

New legislation extended for 3 years the law granting sellers of fertilizer prior liens upon farmers' crops. This has already been in effect 3 years and has resulted in expanding the national consumption of fertilizers. The Government also renewed for a further year the system of export-subsidization instituted in 1935, whereby manufacturers are required to pay a special tax, ranging from 2 to 9 percent of their domestic turn-over, for supplying a national fund from which subsidies are granted exporters to enable them effectively to meet foreign competition. Financial progress of the industry is being retarded by the steadily rising burden of taxation to support the Government's aggressive economic nationalism, rearmament, and public-works programs. A 50-percent increase in corporate income tax was decreed in the latter part of the year, raising the tax from 20 to 30 percent of the total net profits realized. Profits disbursed to shareholders were depressed by compulsory payment into Government loans of all dividends above 8 percent of the nominal stock value and all dividend increases above 6 percent. It is estimated that German companies will pay in taxes 50 to 60 percent of their net profits. The potash industry, drawing its supplies from abundant domestic sources, is little concerned with Government decrees restricting and guiding consumption of raw materials that hamper industries normally dependent on imports or limited domestic resources.

Italy.—Annual production of potassium salts from molasses residues at the plant put in operation in 1935 by L'Appula Soc. Anon. is now reported to be 4,000 tons. The salts produced include chloride, sulphate, bicarbonate, hydroxide, and metabisulphite. It is alleged that a large deposit of potash salts has been discovered near Calascibetta, Enna Province, Sicily. Italy now depends upon foreign countries for its potash requirements. Efforts to produce commercial supplies of soluble potash and aluminum from leucite deposits have been abandoned as uneconomic.

Japan.—Growing demand for potash fertilizers has stimulated efforts to recover potash from various domestic sources. Residual brines from evaporation of sea water to produce salt contain substantial amounts of potash. A professor at the Tokyo Imperial University is reported to have patented a process of treating residual brines with aluminum sulphate to yield potassium sulphate, the aluminum sulphate being recovered for further use. It is estimated that approximately 18,000 metric tons could be recovered annually from residual brines of the salt industry. Two processes are said to have been developed for treatment of molasses at alcohol distilleries to produce potash salts. One process is alleged to recover 95 percent of the potash content of molasses by treatment with aluminum sulphate, the yield of alcohol being unaffected. The production of potash chemical salts likewise is receiving increased attention. Potassium ferrocyanide and potassium permanganate are now being produced by the Mano Chemical Works at the rate of 5 and 10 tons, respectively, per month. Japanese producers of potassium chlorate reached an agreement on March 30, 1937 with the European potassium chlorate syndicate with respect to sales territories and export quotas

for the year 1937. Japan is allocated a total of 6,900 metric tons for the year, representing the entire consumption of Japan and Manchuria, 55 percent of that of China, and a small percentage of other markets.

Mexico.—Discovery of a large deposit of alunite in the State of Guanajuato is reported. The deposit, said to occupy an entire hill 15 miles west of Comonfort, is estmiated by the Instituto de Geologia to contain 2,943,000 tons in sight. The deposit is said to be 40 percent pure alunite and to contain 18.45 percent alumina and 4.57 percent combined potash and soda.

Nigeria.—Exports of potash have approximated 100 long tons annually for the past 5 years. Potash is also said to be an important item in internative trade.

Palestine.—Exports of potash from Palestine increased in 1936 to 23,372 metric tons valued at £132,857 from 18,124 tons valued at £80,231 in 1935. The Palestine Potash, Ltd., concessionaire for extraction of potash and other chemicals from the waters of the Dead Sea, reported production and sales increased in 1936 and prices improved following the conclusion early in the year of agreements with European producers. The political disturbances in Palestine during the year did not affect operations and sales but caused some transport difficulties. Jewish and Arab employees of Palestine Potash, Ltd., worked peaceably side by side throughout the disturbances. Work proceeded on the new plant at the southern end of the Dead Sea that is expected to be ready for operation in 1937. About one-fourth of the area of evaporating pans at the north end of the Dead Sea is in Trans-Jordan.

It is believed that the International Potash Cartel pact with Palestine relates particularly to distribution to the newer markets in Near Eastern and Far Eastern countries that are expected to develop rapidly as the result of the educational and sales propaganda work of the cartel. The Palestine industry is particularly well situated to reach these markets, and it is reported that construction of a cable railway from the Dead Sea to the ocean harbor will reduce f. o. b. ocean-port costs to around 40 percent below those of the German industry.

Poland.—Production of crude salts increased 49,000 metric tons to 434,000 tons, equivalent to 85,000 tons of K_2O, in 1936. This is an all-time high and indicates growing domestic use, since exports, controlled by Poland's quota in the International Potash Cartel, remained virtually stationary at 83,000 tons of merchantable salts. The industry is practically a Government monopoly, the mines being owned by the Government and the sales organization controlled by it through the National Economic Bank. The domestic market is protected by an import duty of 16.50 zlotys ($3.13) per ton. Reserves were estimated in 1935 by the Polish Geological Survey at 450 million tons.

Spain.—Notwithstanding continuance for some months of low prices nominally terminated in April 1935 by agreement with the International Cartel, Spanish producers enjoyed a profitable business in 1935 and faced 1936 with prospects of continued improvement under stabilized market conditions. However, the outbreak of civil war following the revolt of the army closed the mines in the late summer, and about September the directors of the three companies were obliged to flee the country. The mines had continued to operate and

153336—37——89

accumulate stocks at Barcelona for some time after shipments were no longer possible because of the high premiums demanded for insurance. The last shipment of potash from Spain to enter the United States was 1,966 tons of chloride imported in July. The mines are in Catalonia in an area controlled by the Government and are said to have been kept in good condition, under the management of control committees set up by the workers. They are reported to be subject to a new Catalan decree of collectivization for the appropriation of large enterprises. However, it is stated that, in view of the foreign capital in these three companies, the Catalan minister will only settle the question of appropriation after discussion with the owners. In October it was learned that potash was being shipped from Barcelona, and on December 15 the steamer *Beatsa* arrived at London with a cargo believed to be Spanish potash. An injunction was obtained on behalf of the three Spanish companies owning all the potash mines in Spain to prevent delivery of the cargo to the consignees on the ground that it belonged to the mine owners. The court will have to decide whether the mines have been validly sequestered by the Spanish Government. More recently it has been reported that the Spanish Government, badly in need of exports to balance the large import of war materials, will take special measures (presumably price concessions) to foster the export of potash, large stocks of which have accumulated. The mines were reported in December to have resumed operations, and it is said that a project has been drawn up for socializing them and that the product may be dumped abroad at cut prices. In that event, it is conceivable that world markets again may be demoralized by Spanish potash. As yet world trade has not been affected by cessation of shipments from the Spanish mines, as the Spanish quota has been supplied by other members of the International Potash Cartel.

Sweden.—According to a Government survey, potash salts could be produced in southern Sweden in sufficient quantity to supply at least half of the domestic demand.

U. S. S. R. (Russia).—No figures for output of potash in the U. S. S. R. in 1936 are yet available. However, production of the Solikamsk mines is now well-established, having reached 1,319,000 tons in 1935, and it is conceivable that the 1936 quota of 1,800,000 tons may have been approximated. The mine is said to be thoroughly mechanized throughout with modern equipment, but to reach the goal of 3,000,000 tons set for 1937 will require further extension of workings. Labor productivity has shown steady improvement as the workers become more familiar with their tasks. A second mine being equipped near Berezniky is expected to start production before the end of 1937. Soviet officials are fully alive to the benefits of fertilization, and the Commissariat for Agriculture has recommended the use of 1,600,000 metric tons of potash salts a year. The present output of finished salts is around 400,000 tons annually, so it appears that domestic requirements may be expected to absorb expanding output for some years to come. Except for nearby eastern European countries, little Russian potash has appeared in world markets since 1934. Another discovery was reported recently in West Kazakhstan, near the Volga River. The deposits are said to be high in potash content and close to transportation. They are favorably located for supplying the southern part of the country, which suffers seriously from lack of fertilizers.

MICA

By Bertrand L. Johnson and M. A. Cornthwaite

SUMMARY OUTLINE

As a result of increased demand for both uncut sheet mica and scrap mica, the quantity and value of domestic mica sold or used by producers in the United States in 1936 increased over 1935. Sales of scrap mica decreased in North Carolina and New Hampshire but increased in Connecticut. Sales of uncut sheet mica in 1936 were lower in Connecticut but higher in North Carolina and New Hampshire than in 1935.

Total scrap-mica sales, including fine mica obtained in washing kaolin and grinding micaceous schists, increased 2,103 short tons, over 1935, due largely to an advance in the production of byproduct mica and mica from schists, as the production of true scrap rose only 512 tons over 1935. Sales of true scrap in 1936 were 12,697 tons compared with 12,185 tons in 1935. In contrast, sales of mica obtained from washing kaolin and grinding schists increased from 6,667 tons in 1935 to 8,258 in 1936.

Prices of domestic sheet mica rose toward the end of the year. As in 1935, prices of imported sheet mica were higher than those of similar domestic mica. Prices of India splittings showed fractional rises during 1936, and prices of Madagascar splittings were steady throughout the year.

Both the quantity and value of imports of mica in 1936 increased markedly over 1935. Imports of splittings in 1936 were nearly a million and a half pounds greater than in 1935. Exports of mica and mica products in 1936 were slightly less in quantity but somewhat higher in value than in 1935.

The following table summarizes the principal statistics of the mica industry in the United States from 1933 to 1936.

Figure 115 shows the quantity and value of mica splittings and of the better grades of sheet mica imported into the United States since 1926, also the domestic production of sheet mica in sizes larger than punch during the same period.

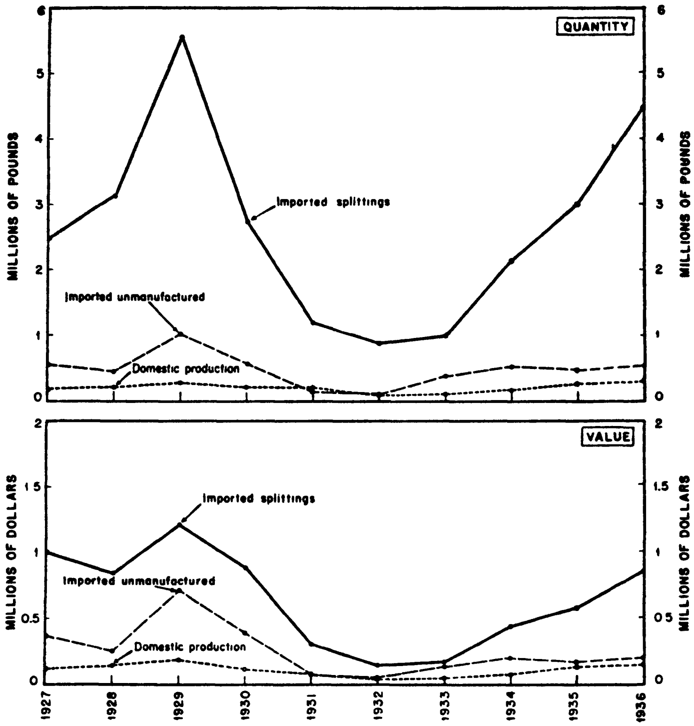


FIGURE 115.—Trends in imports of splittings, and of imports and domestic production of the better grades of sheet mica, 1927–36.

Salient statistics of the mica industry in the United States, 1933–36

	1933	1934	1935	1936
Domestic mica sold or used by producers:				
Uncut sheet:				
Punch and circle:				
Pounds	253, 243	425, 156	670, 327	1, 018, 460
Value	$10, 199	$16, 096	$28, 387	$48, 386
Average per pound	$0. 04	$0. 04	$0. 04	$0. 05
Larger than punch and circle:				
Pounds	111, 297	158, 372	266, 306	300, 773
Value	$42, 980	$74, 172	$132, 763	$155, 493
Average per pound	$0. 39	$0. 47	$0. 50	$0. 52
Total uncut sheet:				
Pounds	364, 540	583, 528	936, 633	1, 319, 233
Value	$53, 179	$90, 268	$161, 160	$203, 879
Average per pound	$0. 15	$0. 15	$0. 17	$0. 15
Scrap:				
Short tons	8, 751	7, 719	[1] 18, 852	[1] 20, 955
Value	$98, 159	$99, 791	[1] $243, 951	[1] $260, 594
Average per ton	$11. 22	$12. 93	$12. 94	$12. 44
Total sheet and scrap:				
Short tons	8, 933	8, 011	[1] 19, 320	[1] 21, 615
Value	$151, 338	$190, 059	[1] $405, 101	[1] $464, 473
Ground:				
Dry-ground: [2]				
Short tons	6, 439	6, 824	15, 178	18, 633
Value	$135, 178	$156, 046	$341, 825	$409, 433
Average per ton	$20. 99	$22. 87	$22. 52	$21. 97
Wet-ground:				
Short tons	3, 392	2, 723	3, 145	[3] 4, 785
Value	$263, 503	$247, 284	$201, 148	[3] $265, 374
Average per ton	$77. 68	$90. 81	$63. 96	$55. 46
Total ground:				
Short tons	9, 831	9, 547	18, 323	[3] 23, 418
Value	$398, 681	$403, 330	$542, 973	[3] $674, 807

See footnotes at end of table.

Salient statistics of the mica industry in the United States, 1933–36—Continued

	1933	1934	1935	1936
Consumption of splittings: [4]				
Pounds	1, 428, 329	1, 763, 035	2, 532, 984	3, 518, 058
Value	$343, 161	$490, 148	$631, 065	$846, 393
Imports for consumption:				
Unmanufactured:				
Pounds	3, 853, 906	7, 688, 458	6, 580, 486	8, 646, 446
Value	$178, 953	$247, 408	$211, 556	$262, 044
Manufactured:				
Cut:				
Pounds	39, 787	68, 619	94, 237	58, 496
Value	$25, 609	$64, 498	$83, 382	$51, 698
Splittings:				
Pounds	1, 343, 329	2, 145, 950	3, 041, 408	4, 467, 288
Value	$255, 401	$442, 949	$584, 657	$848, 518
Built-up:				
Pounds	15, 244	7, 637	32, 495	47, 801
Value	$10, 795	$5, 651	$25, 383	$38, 242
Ground:				
Pounds	537, 776	318, 464		132, 712
Value	$1, 388	$907		$2, 282
All other manufactured:				
Pounds	3, 441	1, 898	7, 867	2, 844
Value	$1, 611	$1, 209	$3, 406	$2, 784
Total manufactured:				
Pounds	1, 939, 577	2, 542, 568	3, 176, 007	4, 709, 141
Value	$294, 804	$515, 214	$696, 828	$943, 524
Total imports:				
Pounds	5, 793, 483	10, 231, 026	9, 756, 493	13, 355, 587
Value	$473, 757	$762, 622	$908, 384	$1, 205, 568
Exports (all classes of mica):				
Pounds	3, 125, 873	3, 502, 498	2, 998, 762	2, 955, 040
Value	$117, 863	$188, 525	$165, 385	$170, 011

[1] Includes mica recovered from kaolin and schists as follows: 1935: 6,667 tons valued at $111,345; 1936: 8,258 tons valued at $127,343.
[2] Includes fine unground mica recovered in washing kaolin and, in 1935 and 1936, mica recovered by milling mica schist.
[3] Includes a small quantity of scrap imported for grinding.
[4] Exclusive of a nominal quantity of splittings produced in South America and the United States.

PRODUCTION

Sheet and scrap.—The quantity and value of the domestic production of both sheet and scrap mica increased in 1936 over those in 1935. The domestic production came principally from three States—Connecticut, New Hampshire, and North Carolina. Other producing States were Alabama, Arizona, Colorado, Georgia, Maine, New Mexico, South Carolina, South Dakota, and Virginia. The quantity and value of scrap mica produced in New Hampshire and North Carolina decreased and increased in Connecticut. Production of uncut sheet mica in Connecticut in 1936 was below the level of 1935, but the value of the production increased. Increases were reported in both the quantity and the value of production from New Hampshire and North Carolina. The following tables show the quantity and value of the various classes of domestic mica sold or used by producers in the United States and in the producing States of New Hampshire and North Carolina for 1932 to 1936 and Connecticut for 1935 and 1936. From 1932 to 1934 there were too few producers of mica in Connecticut to permit publication of the figure for the sales of mica.

Domestic mica sold or used by producers in the United States, 1932–36

Year	Sheet mica						Scrap mica		Total	
	Uncut punch and circle mica		Uncut mica larger than punch and circle		Total uncut sheet mica					
	Pounds	Value	Pounds	Value	Pounds	Value	Short tons	Value	Short tons	Value
1932	258,512	$7,976	80,485	$37,906	338,997	$45,882	7,040	$83,777	7,209	$129,659
1933	253,243	10,199	111,297	42,980	364,540	53,179	8,751	98,159	8,933	151,338
1934	425,156	16,096	158,372	74,172	583,528	90,268	7,719	99,791	8,011	190,059
1935	670,327	28,387	266,306	132,763	936,633	161,150	[1] 18,852	[1] 243,951	[1] 19,320	[1] 405,101
1936	1,018,460	48,386	300,773	155,493	1,319,233	203,879	[1] 20,955	[1] 260,594	[1] 21,615	[1] 464,473

[1] Includes mica recovered from kaolin and schists as follows—1935: 6,667 tons valued at $111,345; 1936: 8,258 tons valued at $127,343.

Mica sold or used by producers in chief producing States, 1932–36

State and year	Sheet mica						Scrap mica		Total	
	Uncut punch and circle mica		Uncut mica larger than punch and circle		Total uncut sheet mica					
	Pounds	Value	Pounds	Value	Pounds	Value	Short tons	Value	Short tons	Value
Connecticut: [1]										
1935	169,923	$5,943	95,327	$46,817	265,250	$52,760	620	$10,171	753	$62,931
1936	156,232	6,750	92,952	49,900	249,184	56,650	705	11,741	830	68,391
New Hampshire:										
1932	121,487	3,607	24,527	14,371	146,014	17,978	344	5,585	417	23,563
1933	117,333	3,940	50,131	18,068	167,464	22,008	532	9,563	616	31,571
1934	118,508	3,788	42,922	10,635	161,430	14,423	537	9,529	618	23,952
1935	95,112	3,869	36,474	9,858	131,586	13,727	394	5,335	460	19,062
1936	238,845	10,133	46,977	12,787	285,822	22,920	250	3,610	393	26,530
North Carolina:										
1932	85,803	2,906	41,893	15,416	127,696	18,322	4,837	56,842	4,901	75,164
1933	117,826	5,322	44,846	15,785	162,672	21,107	6,918	74,711	6,999	95,818
1934	225,967	9,080	67,414	29,594	293,381	38,674	4,757	59,496	4,904	98,170
1935	401,605	18,411	110,985	59,187	512,590	77,598	[2] 11,831	[2] 153,553	[2] 12,087	[2] 231,151
1936	575,915	29,105	154,531	90,548	730,446	119,653	[2] 10,840	[2] 131,138	[2] 11,205	[2] 250,791

[1] Bureau of Mines not at liberty to publish figures for earlier years.
[2] Includes mica recovered from kaolin and schists as follows—1935: 4,299 tons valued at $75,659; 1936: 5,265 tons valued at $82,903.

Ground mica.—The quantity of ground mica sold by domestic producers in 1936 was 23,418 short tons valued at $674,807, compared with 18,323 tons valued at $542,973 in 1935. The 1935 and 1936 figures given in the tables for ground mica and scrap mica include ground muscovite, sericite, and chlorite schists, therefore they are not comparable with those for earlier years which did not include the production from schists.

The following companies, classified according to their method of grinding, reported production of ground mica to the Bureau of Mines in 1936:

	Process
Asheville Mica Co., Biltmore, N. C	Dry.
Concord Mica Co., Concord, N. H	Wet.
Franklin Mineral Products Co., Franklin, N. C	Do.
General Mica Co., Inc., Pueblo, Colo	Dry.
Newdale Mica Co., Irwin, Tenn	Do.
Richmond Mica Corporation, 323 South 9th St., Richmond, Va	Wet.
Southern Mica Co., Johnson City, Tenn	Dry.
Southern Mining & Milling Co., Clarkesville, Ga	Wet.
Standard Oil Co., 910 South Michigan Ave., Chicago, Ill	Dry.
U. S. Mica Manufacturing Co., 1521–1527 Circle Ave., Forest Park, Ill	Do.
D. T. Vance, Plumtree, N. C	Wet.
Vance-Barrett, Inc., Plumtree, N. C	Do.

The following tables show the quantity and value of wet-ground and dry-ground mica sold by producers in the United States from 1932 to 1936 and sales by uses in 1936. Sales of ground mica for use in paint, which are shown for the first time for 1936, represented 6 percent of the total sales and ranked third among the uses of ground mica. The figures for dry-ground mica include sales of byproduct mica recovered by the Harris Clay Co. and the General Mica Co. in washing kaolin in Mitchell County, N. C., and for 1935 and 1936 the product obtained by grinding muscovite, sericite, and chlorite schists. Sales of this latter material in 1936 were reported by L. E. Shepard, Buckeye, Ariz.; Thompson Weinman & Co., Inc., Cartersville, Ga.; and Victor Mica Co., Spruce Pine, N. C.

Ground mica sold by producers in the United States, 1932–36, by methods of grinding

Year	Dry ground		Wet ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1932	5,253	$126,714	2,452	$184,126	7,705	$310,840
1933	6,439	135,178	3,392	263,503	9,831	398,681
1934	6,824	156,046	2,723	247,284	9,547	403,330
1935	[1] 15,178	[1] 341,825	3,145	201,148	[1] 18,323	[1] 542,973
1936	[1] 18,633	[1] 409,433	[2] 4,785	[2] 265,374	[1] 23,418	[1] 674,807

[1] Includes ground mica from schist.
[2] Includes a small quantity of scrap imported for grinding.

Ground mica sold to various industries in the United States in 1936

Industry	Quantity [1]		Value
	Short tons	Percent of total	
Roofing [2]	18,112	77	$384,884
Wall paper	2,869	12	166,315
Paint	1,307	6	71,155
Rubber	516	2	27,012
Miscellaneous [3]	614	3	25,441
	23,418	100	674,807

[1] Includes a small quantity of scrap imported for grinding.
[2] Includes ground mica from schist.
[3] Figures cover mica used for molded electric insulation, surfacing on asphalt shingles, Christmas-tree snow, manufacture of axle greases and oil, annealing, concrete and foundry facing, pipe-line enamel, plastic specialties, and other purposes.

Figure 116 shows trends in the percentage of ground mica used in various industries from 1927 through 1936. During this period the roofing industry has become the major outlet and the wallpaper and rubber industries, which formerly were important users, now use relatively little.

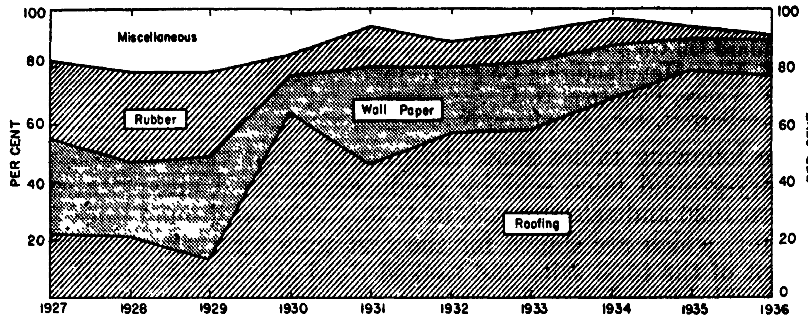


FIGURE 116.—Percentage of ground mica used by consuming industries in the United States, 1927-36.

CONSUMPTION AND STOCKS OF MICA SPLITTINGS

The consumption of mica splittings, a raw material of major importance in the domestic mica-products industry, exceeded 3,500,000 pounds in 1936, a marked increase over 1935. Virtually the entire supply was imported, as the domestic mica industry yields only a few thousand pounds of these thin flakes annually. Nearly 90 percent came from India, the world's largest producer of mica splittings, which furnished to United States consumers over 901,000 pounds more than in 1935. Domestic consumption of mica from Madagascar likewise increased over 1935, but that of mica from Canada declined.

Stocks of mica splittings in the hands of consumers on December 31, 1936, were slightly greater than at the end of 1935. Stocks of Indian and Madagascan splittings were larger than in 1935 and more than counterbalanced the decline in stocks of Canadian mica splittings.

The accompanying tables show the quantity, value, and source of mica splittings consumed in the United States from 1932 to 1936 and stocks in the hands of consumers on December 31, 1935 and 1936.

Mica splittings consumed in the United States, 1932-36, by sources, as reported by the consumers [1]

Year	India		Canada		Madagascar	
	Pounds	Value	Pounds	Value	Pounds	Value
1932	666,911	$193,309	73,810	$13,655	157,528	$61,321
1933	1,088,796	233,075	84,494	24,412	255,039	85,674
1934	1,423,635	350,561	94,422	37,903	244,978	101,684
1935	2,150,593	492,161	129,272	42,897	253,119	96,007
1936	3,051,824	649,982	102,766	44,566	363,468	151,845

[1] Exclusive of a nominal quantity of splittings produced in South America and the United States.

Stocks of mica splittings in hands of consumers in the United States, Dec. 31, 1935–36

Source	1935		1936	
	Pounds	Value	Pounds	Value
Canada	139, 019	$57, 286	52, 014	$19, 048
India	1, 011, 864	259, 201	1, 280, 517	304, 036
Madagascar	213, 421	82, 908	223, 357	101, 711
	1, 364, 304	399, 395	1, 555, 888	424, 795

MARKET AND PRICES

Domestic sheet mica.—Demand for sheet mica for electrical purposes was strong throughout the year, and as domestic production was inadequate to supply the demand considerable quantities were imported from India, Brazil, and Argentina. Prices of domestic mica rose toward the end of the year, carrying the 1936 average above that of 1935. The accompanying table shows the range in prices of domestic uncut mica f. o. b. North Carolina, as reported in Metal and Mineral Markets. These prices apply both to No. 1 and No. 2 clear; stained mica is 10 to 25 percent less than the prices given. The form of table is slightly different from that used in previous years to show the increases in prices of the larger grades that occurred at intervals in 1936.

Range in prices per pound for domestic uncut sheet mica in 1936

Size	Price per pound	Size	Price per pound
Punch	$0. 03–$0. 05	3 by 4 inches: Jan. 1–Apr. 18	$0. 90–$1. 25
½ by 2 inches	. 15– . 30	Apr. 19–Dec. 31	1. 00– 1. 25
2 by 2 inches	. 30– . 50	3 by 5 inches	1. 25– 1. 50
2 by 3 inches: Jan. 1–May 16	. 50– . 65	4 by 6 inches: Jan. 1–Apr. 18	1. 50– 2. 50
May 17–Dec. 31	(1)	Apr. 19–Dec. 31	2. 00– 2. 50
3 by 3 inches: Jan. 1–Apr. 18	. 65– . 85	6 by 8 inches	2. 50– 3. 50
Apr. 19–May 16	. 75– 1. 00	8 by 10 inches: Jan. 1–May 16	4. 00– 5. 00
May 17–Dec. 31	. 75– 1. 10	May 17–Dec. 31	3. 50– 5. 00

[1] Not quoted.

Foreign sheet mica.—Considerable stained sheet mica for electrical purposes was imported to supplement domestic supplies in 1936, and, as in 1935, the prices of this imported mica were higher than those of similar domestic mica. Except for some cheaper stained material from Madras, Brazil, and Argentina, most of the sheet mica imported was large, clear mica for special purposes; No. 6 "good-stained" mica for tube supports; and Nos. 5, 5½, and 6 grades of split condenser mica. London prices for sheet mica of electrical quality rose moderately during the year, but the outstanding feature of the market was the sharp increase in the prices of all grades of superfine clear and slightly stained mica of any origin and of special and better grades of good sheet. During the year all stocks of clear and slightly stained mica are reported to have been exhausted, and the supply was insufficient for the demand. Prices for mica of this quality at the end of the year were well above the average for the year. In general, the market for all classes of sheet mica on January 1, 1937, was firm, with an upward tendency.

There are no definite New York quotations for foreign mica, but the following table, based on actual sales during the year, gives a close approximation of New York prices.

Approximate average prices per pound of uncut sheet mica in New York in 1936

Domestic			India (duty paid)[1]					
Size (inches)	Clear	Black spotted	Size (number)	Clear and slightly stained	Fair stained	Good stained	Stained	Black spotted
1½ by 2	$0.40	$0.15	6	$1.09	$0.79	$0.49	----------	----------
2 by 2	.60	.25	5	3.79	1.84	1.54	$0.56½	$0.34
2 by 3	.90	.40	4	4.09	2.74	1.84	1.24	.74
3 by 3	1.35	.55	3	5.14	2.89	2.74	1.84	1.09
3 by 4	1.60	.75	2	6.94	3.04	3.04	2.44	1.54
3 by 5	1.85	.95	1	8.44	4.09	4.09	3.34	2.06½
4 by 6	2.40	1.00	A-1	9.94	6.04	5.89	4.84	2.21
6 by 8	3.25	1.10	Special	12.64	10.54	8.44	7.54	2.29

[1] Prices of India mica calculated on basis of £1 equals $4.80.

Splittings.—While the prices of India splittings in 1936 showed only fractional rises, consumption increased rapidly in November and December and continued heavy in the first quarter of 1937. In fact, during the first quarter of 1937 the quantity of India splittings used in the United States was more than double that used in the corresponding months of 1936. The increased consumption was reflected by heavy buying which commenced in January 1937. This heavy buying and increased demand in Europe absorbed all available stocks in India and London and caused sharp rises in the prices of all grades of India splittings, which in May 1937 were selling at 50 to 75 percent above the 1936 averages.

Average prices for India splittings, ruby muscovite, duty paid, in New York in 1936 were as follows: No. 4, book-packed, $1.20; loose $0.75; No. 5, book-packed, $0.80; loose $0.53; No. 5½, book-packed, $0.75; loose, $0.30; No. 6, book-packed, $0.55; No. 6, first-quality, loose, $0.23; No. 6, second-quality, loose, $0.175; No. 6, third-quality, loose, $0.13; cheap, loose, $0.10.

Consumption of Madagascar splittings early in 1937 was also more than double that of a year earlier. Prices, however, remained steady, probably being influenced by the devaluation of the French franc. Average prices in 1936 for Madagascar splittings, phlogopite, duty paid, New York, were as follows: No. 4, loose, 65 cents a pound; No. 5, loose, 50 cents a pound; and No. 6, loose, 43 cents a pound.

Scrap.—The average price of domestic scrap mica f. o. b. mill in 1936 was $12.44 a ton; in 1935, it was $12.94.

Ground mica.—The average price of dry-ground mica f. o. b. mill in 1936 was $21.97 compared with $22.52 a ton in 1935. Wet-ground mica sold at an average price of $55.46 a ton in 1936 compared with $63.96 a ton in 1935.

FOREIGN TRADE [1]

Imports.—Imports of mica in 1936 totaled 13,355,587 pounds valued at $1,205,568 compared with 9,756,493 pounds valued at $908,384 in 1935. Imports of unmanufactured mica (8,646,446 pounds valued at $262,044) and imports of manufactured mica (4,709,141 pounds valued at $943,524) also increased in quantity and value over 1935. Imports of splittings in 1936 exceeded those in 1935 by 1,425,880 pounds. The accompanying table shows the classification, quantity, and value of mica imported for consumption in the United States in 1936 and the countries from which it was last shipped.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Mica imported for consumption in the United States in 1936, by kinds and by countries

Country	Unmanufactured								Manufactured			
	Waste and scrap, valued at not more than 5 cents per pound (duty, 25 percent)		Untrimmed phlogopite mica from which no rectangular piece exceeding in size 1 inch by 2 inches may be cut (duty, 15 percent)		Other				Cut or stamped to dimensions, shape, or form			
					Valued at not above 15 cents per pound (duty, 4 cents per pound)		Valued above 15 cents per pound (duty, 4 cents per pound +25 percent)		Cut (duty, 40 percent)		Disks (duty, 40 percent)	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Africa:												
British South, Other [1]					1,024	$147						
Madagascar					46	5	4,103	$1,268				
Argentina					79,225	8,486	70,638	23,597				
Brazil					60,613	7 949	68,784	27,578	148	$327		
Canada	2,368,920	$11,643	30,131	$2,593	21,888	2,122	9,747	4,077	154	88		
Ceylon					447	43	185	53				
France					2,200	284	434	293				
Germany									12,270	16,373		
India, British	5,417,273	11,023			82,455	10,431	308,489	99,301	31,416	25,608	10,550	$5,266
Japan									500	603		
United Kingdom					42,311	4,848	77,533	46,303	2,535	3,216	923	217
	7,786,193	22,666	30,131	2,593	290,209	34,315	539,913	202,470	47,023	46,215	11,473	5,483

[1] Rhodesia (Northern and Southern), Bechuanaland, and Nyasaland Protectorates.

Country	Manufactured—Continued											
	Films and splittings						Mica plates and built-up mica (duty, 40 percent)		All manufactures of which mica is the component material of chief value (duty, 40 percent)		Ground or pulverized	
	Not cut or stamped to dimensions				Cut or stamped to dimensions (duty, 45 percent)							
	Not above 12 ten-thousandths of an inch in thickness (duty, 25 percent)		Over 12 ten-thousandths of an inch in thickness (duty, 40 percent)									
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Africa: Madagascar	342, 361	$80, 841										
Brazil	268	79										
Canada	17, 820	7, 162	51, 550	$11, 989			60	$82	24	$24	132, 600	$2, 265
Ceylon	468	14										
France	103, 723	28, 545										
Germany			2, 748	2, 492	767	$5, 767	31, 545	28, 589	2, 820	2, 760		
India, British	3, 354, 828	489, 343	530, 582	202, 924	2, 434	2, 058						
Japan	3, 125	374										
Norway	5, 153	1, 267										
United Kingdom	49, 564	14, 684	1, 897	979			16, 196	9, 571			112	17
	3, 877, 310	622, 309	586, 777	218, 384	3, 201	7, 825	47, 801	38, 242	2, 844	2, 784	132, 712	2, 282

Exports.—Exports of mica and manufactures thereof in 1936 (2,955,040 pounds valued at $170,011) were slightly less in quantity but a little greater in value than those in 1935 (2,998,762 pounds valued at $165,385). Exports of unmanufactured mica in 1936 amounted to 367,672 pounds valued at $6,671, and those of manufactures of mica 2,587,368 pounds valued at $163,340. The accompanying table shows the quantity, value, and destination of mica and mica products exported from the United States in 1936.

Mica and manufactures of mica exported from the United States in 1936, by countries

Country	Unmanufactured		Manufactured and manufactures of	
	Pounds	Value	Pounds	Value
North America:				
Canada	84,085	$1,106	409,665	$61,494
Central America:				
Panama			50	75
Salvador			4	52
Mexico			44,058	4,429
Newfoundland and Labrador			15	63
West Indies:				
British:				
Jamaica	22	14	18	61
Trinidad and Tobago			38	30
Cuba			476	842
Netherland			612	198
South America:				
Argentina	2,000	44	9,879	1,769
Bolivia			965	825
Brazil	115	92	2,573	3,062
Chile	66	124	1,591	2,581
Colombia			585	302
Ecuador			43	66
Paraguay			6	24
Peru			106	269
Uruguay			510	262
Venezuela			6,749	435
Europe:				
Belgium			380,555	12,132
Czechoslovakia			63	44
Denmark			2,000	112
Estonia			85	30
France			106,341	4,571
Germany	5,200	155	397,976	14,813
Irish Free State			3,030	116
Netherlands	72	86	38,758	6,177
Norway			14	32
Poland and Danzig			4,242	164
Portugal			27	15
Rumania			371	261
Spain			15,721	451
Sweden			4,807	380
Switzerland			4,000	112
United Kingdom	274,094	4,939	1,116,578	42,803
Asia:				
China			742	697
India, British			1,591	881
Indochina			13,202	545
Japan			3,300	105
Philippine Islands	18	61	899	834
Africa:				
British West (other)			11	38
Mozambique			195	372
Union of South Africa	2,000	50	14,328	687
Oceania:				
Australia			538	87
New Zealand			51	42
	367,672	6,671	2,587,368	163,340

WORLD PRODUCTION

The following table shows world production of mica from 1932 to 1936 insofar as figures are available.

World production of mica, 1932–36, in metric tons

[Compiled by M. T. Latus]

Country	1932	1933	1934	1935	1936
North America:					
Canada (sales)	280	857	905	570	636
United States (sold or used by producers)	6,540	8,104	7,267	[1] 17,527	[1] 19,609
South America:					
Argentina [2]	55	75	175	(3)	(3)
Bolivia [4]	8	2	4	2	(3)
Brazil [4]	42	23	59	110	237
Europe:					
Italy	9	3	5	(3)	(3)
Norway [4]	103	105	170	56	(3)
Sweden	61	68	16	32	(3)
U. S. S. R. (Russia)	(5)	(5)	(5)	(5)	(3)
Asia:					
Ceylon [4]	2	(6)	(6)	2	----------
Chosen	20	23	103	87	(3)
India, British [7]	2,389	2,878	4,720	7,204	(3)
U. S. S. R. (Russia)	7,075	5,721	4,433	8,274	(3)
Africa:					
Eritrea	20	(6)	----------	----------	4
Madagascar [8]	140	173	294	521	(3)
Rhodesia:					
Northern	----------	2	1	2	3
Southern	13	4	2	4	9
Tanganyika Territory	12	11	31	46	44
Union of South Africa (Transvaal) (sales)	250	549	278	193	384
Oceania: Australia:					
New South Wales	----------	41	91	----------	(3)
Northern Territory (Central Australia)	30	43	49	44	21

[1] Includes following quantities recovered from kaolin and schists: 1935, 6,048 tons; 1936, 7,491 tons.
[2] Rail and river shipments.
[3] Data not available.
[4] Exports.
[5] Output of U. S. S. R. in Europe included under U. S. S. R. in Asia.
[6] Less than 1 ton.
[7] Exports. The figures for output are incomplete, and a more accurate idea of the size of the industry can be obtained from the export figures. (Rec. Geol. Survey of India, vol. 59, pt. 3, p. 273, Calcutta, 1926.) Output is reported as follows: 1932, 1,662 tons; 1933, 2,087 tons; 1934, 2,830 tons; 1935, 2,985 tons.
[8] Exports reported as follows: 1932, 130 tons; 1933, 246 tons; 1934, 369 tons; 1935, 408 tons; 1936, 478 tons.

SALT, BROMINE, CALCIUM CHLORIDE, AND IODINE

By A. T. Coons and F. E. Harris [1]

SUMMARY OUTLINE

SALT

Salt produced for sale or use by operators of salt mines, wells, and ponds in the United States in 1936 totaled 8,828,936 short tons, 11 percent more than in 1935, 3 percent more than the former peak production of 8,543,560 tons in 1929, and 38 percent more than the low level of 6,407,973 tons in 1932. The output was valued at $23,306,177 compared with $21,837,911 in 1935, an increase of 7 percent. The average value in 1936 was $2.64 a ton, 11 cents less than in 1935. The output of all classes of salt increased in 1936. The total output of dry salt sold (rock and evaporated) increased 11 percent, and the salt content of the brine used in the manufacture of chemicals increased 12 percent.

Seventy-two plants (58 companies) reported operation in 1936 compared with 74 plants (60 companies) in 1935.

Of the 58 companies reporting operation in 1936, 7 large companies, including producers of evaporated salt, rock salt, and brine, produced about 47 percent of the total. In addition, 16 medium-size companies produced about 44 percent, and the remaining 36 small companies produced 9 percent.

According to H. I. Smith, of the United States Geological Survey, the salt produced from leases on public domain administered by the United States Government amounted to 7,132.12 short tons valued at $14,908 in 1936. The royalty on the salt ranged from 2 to 5 percent of the gross value and totaled $625.37.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Salient statistics of the salt industry in the United States, 1934–36

	1934	1935	1936
Sold or used by producers:			
Manufactured (evaporated) short tons	2,281,453	2,330,042	2,539,597
In brine do	3,417,439	3,837,613	4,279,760
Rock salt do	1,913,182	1,759,242	2,009,579
Total quantity do	7,612,074	7,926,897	8,828,936
Total value [1]	$22,850,797	$21,837,911	$23,306,177
Average value per ton [1]	$3.00	$2.75	$2.64
Imports:			
For curing fish short tons	31,734	26,990	21,711
Value	$56,662	$53,623	$44,382
In bags, barrels, etc. short tons	2,296	1,960	1,388
Value	$19,334	$15,590	$12,263
In bulk short tons	19,094	22,295	27,941
Value	$44,524	$38,558	$56,137
Total quantity short tons	53,124	51,245	51,040
Total value	$120,520	$107,771	$112,782
Exports:			
Total quantity short tons	105,365	112,213	76,974
Total value	$615,724	$549,522	$463,670

[1] The values are f. o. b. mine or refinery and do not include cost of cooperage or containers.

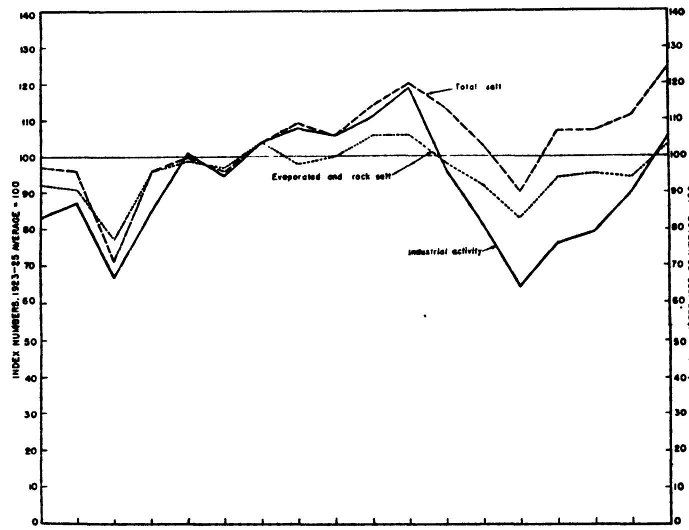


FIGURE 117.—Index of salt sold or used compared with Federal Reserve Board index of industrial activity, 1919–36.

If the average annual salt production for 1923–25 is taken as 100 and compared with the Federal Reserve Board index of general business, the accompanying graph (fig. 117) reveals that the production of all kinds of salt followed the index of general industrial activity closely for a number of years. Salt production remained relatively high during the depression—at the lowest point in 1932 the index was 26 points above that of general business—and climbed to an all-time high in 1936. The dry-salt curve, which is relatively inflexible because of the large quantity used by the food industries, lagged behind the index of general business from 1925 to 1929 but did not drop so low during the depression years. Although shipments increased in 1936 compared with 1935, the output of dry salt was less than the 1929 peak, and the index fell slightly below that of business in general.

The use of chlorine increased in 1936, particularly in the South where new kraft-paper mills are springing up rapidly, forecasting increased salt production. At least one large company already is reported to have perfected plans for a new chlorine plant in Louisiana.

Imports, which were never large compared with domestic output, remained virtually unchanged in 1936, and exports declined. As in past years, exports exceeded imports by a wide margin. Table salt predominates in the exports and crude salt in the imports. Increased activity in the fishing industry of the Eastern Shore of Virginia has resulted in a steady increase in imports of salt for curing fish, and in 1936 they almost equaled the combined receipts of the two customs districts, Maine and New Hampshire, and Massachusetts.

PRODUCTION

The vast resources of salt in the United States tend to foster overdevelopment, and existing mines commonly are idle part of the year. This situation has led to consolidation of some companies. Usually there are no seasonal changes in the level of the salt business. Local conditions, such as canneries that consume large quantities of salt during their canning season, may affect consumption in some parts of the country, and the rainy season on the west coast influences the production of solar salt, but the variation in a year for the entire country is small.

Minerals Yearbook, 1936 (p. 920), contains a directory showing producing companies, location of plants, and class of salt produced, marketed, or used by them. The following changes and additions to this directory bring it up to date through 1936.

In 1936 the Arden Salt Co. and the Leslie California Salt Co., operating in Alameda County, Calif., were consolidated and now operate as the Leslie Salt Co. (address, 310 Sansome Street, San Francisco, Calif.). The Irvine Salt Co., Tustin, Calif., started operations but made no production. The Michigan Chemical Corporation, producing evaporated salt and bromine, started operations at St. Louis, Mich., and the Great Lakes Chemical Corporation had a plant under construction at Filer City, Mich. At Carlsbad, Eddy County, N. Mex., salt recovered as a part of the process of refining potassium salts at the plant of the Potash Co. of America was marketed by the Salt Supply Co., Carlsbad, N. Mex.

Further interest is attached to the merger of the Leslie-California Salt Co. with the Arden Salt Co., which has interesting and unique methods of harvesting the solar salt, as the Alviso Salt Co., previously taken over by the Arden Salt Co., pioneered in the methods of harvesting solar salt.

By one of the methods employed a Diesel-powered harvester, especially designed for handling crude salt, travels across the pond, picks up the salt that has been deposited on the bottom of the pond, and unloads it in dump cars that run on a portable track alongside. Another method used is to harvest the salt automatically with a tractor-powered machine having an endless belt that picks it up and conveys it to dump cars hauled by a miniature gasoline locomotive. The salt goes in cars to the washer, to an elevator conveyor, and thence to outside storage piles, where it is kept until final shipment is made. The steep sides of the storage piles become caked with a hard crust that is impervious to the rain.

Production by States.—Michigan continued to be the leading salt-producing State, followed by New York, Ohio, Louisiana, and Kansas.

Salt sold or used by producers in the United States, 1934–36, by States

State	1934		1935		1936	
	Short tons	Value	Short tons	Value	Short tons	Value
California	341,893	$2,026,376	356,222	$2,182,643	368,290	$2,576,873
Kansas	768,133	2,949,930	608,204	2,309,482	704,164	2,580,166
Louisiana	567,289	2,854,785	702,990	2,514,896	918,414	2,436,971
Michigan	2,012,370	5,470,684	2,128,171	5,337,536	2,354,282	5,882,718
New York	1,866,280	5,263,394	1,927,822	5,331,133	2,021,983	5,609,932
Ohio	1,432,292	2,721,167	1,487,315	2,697,858	1,633,056	2,545,027
Puerto Rico	(1)	(1)	12,582	51,723	10,951	43,705
Texas	208,979	612,586	268,809	563,514	316,006	615,815
Utah	(1)	(1)	57,625	163,639	56,480	168,706
West Virginia	66,766	384,342	65,968	433,855	117,401	719,382
Undistributed [2]	348,072	567,533	311,189	251,632	327,909	126,882
	7,612,074	22,850,797	7,926,897	21,837,911	8,828,936	23,306,177

[1] Included under "Undistributed".
[2] 1934, Nevada, New Mexico, Oklahoma, Puerto Rico, Utah, and Virginia; 1935, Nevada, New Mexico, Oklahoma, and Virginia; 1936, New Mexico, Oklahoma, and Virginia.

Evaporated salt.—Evaporated salt, produced either from the original brine of wells and ponds or from brine obtained by forcing water into beds of rock salt and withdrawing it for processing, represented 29 percent of the quantity of salt produced in 1936. The output, 2,539,597 short tons valued at $15,581,148, increased 9 percent in quantity and 5 percent in value over 1935. These figures include salt blocks made from evaporated salt and sold mostly for cattle licks. In 1936 the production of salt blocks from evaporated salt amounted to 134,586 short tons valued at $965,114, an increase of 7 percent in both quantity and value over 1935. The average value per ton of all evaporated salt was $6.14, 20 cents less than in 1935. Due to the processing methods applied to this class of salt, the average unit value is higher than that of rock salt.

Michigan retained first place as a producer of evaporated salt, followed by Ohio, New York, California, and Kansas. In 1936, 38 plants reported sales of salt processed by vacuum-pan or grainer systems, 18 sold solar-evaporated salt, and 17 made blocks from evaporated salt.

Evaporated salt sold or used by producers in the United States, 1935–36, by States

State	1935		1936	
	Short tons	Value	Short tons	Value
California	350,220	$2,155,634	360,840	$2,543,348
Kansas	229,570	1,562,840	248,099	1,650,792
Michigan	732,327	3,842,224	836,524	4,240,331
New York	377,985	3,412,540	388,278	3,443,644
Ohio	386,005	2,443,470	414,046	2,264,991
Puerto Rico	12,582	51,723	10,951	43,705
West Virginia [1]	65,968	433,855	117,401	719,382
Undistributed [2]	175,385	870,665	163,458	674,955
	2,330,042	14,772,951	2,539,597	15,581,148

[1] Includes a quantity of salt content of brine for chemical use reported as evaporated salt with value as evaporated salt.
[2] Louisiana, New Mexico, Oklahoma, Texas, and Utah.

Rock salt.—The output of rock salt was 2,009,579 short tons valued at $6,003,054 in 1936 compared with 1,759,242 tons valued at $5,510,413 in 1935, an increase of 14 percent in quantity and 9 percent in value. The average value of rock salt in 1936 was $2.99 a ton, 14 cents less than in 1935. The figures for rock salt include pressed blocks made from rock salt which amounted to 34,489 short tons valued at $222,864 in 1936, an increase of 40 percent in quantity and 43 percent in value over 1935. Nineteen plants reported production of rock salt in 1936, and seven plants produced blocks. In 1936 New York, Louisiana, Kansas, and Michigan produced 93 percent of the rock salt mined. Other States reporting production of rock salt were Texas, California, Utah, and New Mexico. On account of the small number of producers of rock salt and salt in brine for chemical manufacture and of rock salt and evaporated salt in certain States, it is impossible to show either rock salt or salt in brine used for chemicals separately by States, if State totals for all classes of salt are published.

Rock salt sold by producers in the United States, 1932–36

Year	Short tons	Value	Year	Short tons	Value
1932	1,584,731	$5,100,779	1935	1,759,242	$5,510,413
1933	1,784,992	5,570,352	1936	2,009,579	6,003,054
1934	1,913,182	6,306,095			

Salt content of brine.—The quantity of salt in brine sold or used by producers for the manufacture of chemicals in 1936 was 4,279,760 short tons, an increase of 12 percent over 1935. This class of salt represented 48 percent of the total output and was produced at 10 plants—at Cameron and Iberville Parishes, La.; Detroit and Wyandotte, Mich. (2 plants); Barberton and Painesville, Ohio; Tully, N. Y.; Benavides, Tex.; and Saltville, Va.

Pressed blocks.—The production of pressed blocks from both evaporated and rock salt reported by the original producers of the salt and shown in the following table does not represent the entire pressed-block industry, as some firms that do not produce salt make pressed blocks from salt bought in the open market. The total production of blocks in 1936 was 169,075 short tons valued at $1,187,978, an increase of 12 percent in both quantity and value over 1935. Eighty percent of the blocks were made from evaporated salt, and the output of each class increased in 1936. Pressed blocks from evaporated salt are made chiefly by salt producers in Kansas and Michigan, but are also produced in California, Texas, Utah, Ohio, Louisiana, and New York. Pressed blocks from rock salt are made chiefly by producers in Louisiana and Kansas, and small amounts are made in Texas.

Pressed-salt blocks sold by original producers of the salt in the United States, 1932–36

Year	From evaporated salt		From rock salt		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1932	119,238	$848,194	26,504	$153,251	145,742	$1,001,445
1933	152,670	1,129,821	30,505	168,834	183,175	1,298,655
1934	139,445	999,170	29,344	166,269	168,789	1,165,439
1935	126,005	900,040	24,691	156,002	150,696	1,056,042
1936	134,586	965,114	34,489	222,864	169,075	1,187,978

SHIPMENTS

Shipments of evaporated and rock salt in the United States in 1935 and 1936, given in the following table, were compiled from reports of producers. No account was taken of reshipment beyond the original destination indicated when the salt left the producing plant. The figures contain no salt shipped by jobbers, dealers, or producers shipping salt obtained from other producers.

Distribution (shipments) of evaporated and rock salt in continental United States, 1935–36, by States, in short tons

Destination	1935		1936 [1]	
	Evaporated	Rock	Evaporated	Rock
Alabama	6,080	30,620	6,463	26,302
Arizona	6,262	1,226	6,602	1,238
Arkansas	9,628	15,323	4,711	18,604
California	220,249	6,233	222,858	7,250
Colorado	13,996	5,948	12,026	4,506
Connecticut	13,091	5,134	13,716	6,629
Delaware	2,549	13,816	3,515	32,622
District of Columbia	4,943	1,462	4,660	1,161
Florida	5,343	18,901	5,391	15,709
Georgia	12,545	39,312	13,464	35,443
Idaho	9,880	494	11,512	445
Illinois	202,513	119,595	229,343	134,509
Indiana	64,999	46,582	72,519	47,126
Iowa	49,731	58,446	48,199	57,599
Kansas	26,894	126,013	19,511	71,625
Kentucky	27,949	16,596	31,463	19,127
Louisiana	5,278	44,838	4,396	46,951
Maine	8,581	14,083	9,293	20,023
Maryland	21,623	20,315	25,357	25,004
Massachusetts	61,449	33,671	59,187	32,680
Michigan	206,294	40,022	228,311	40,205
Minnesota	54,186	49,694	62,149	54,670
Mississippi	2,226	27,266	2,136	25,104
Missouri	51,323	39,209	44,825	43,303
Montana	12,836	1,801	11,351	969
Nebraska	20,478	25,232	17,655	27,059
Nevada	2,116	65	2,143	133
New Hampshire	5,534	26,657	7,046	27,485
New Jersey	53,509	85,340	67,423	104,528
New Mexico	5,529	2,976	2,117	6,959
New York	188,354	292,213	194,077	325,806
North Carolina	30,418	33,670	38,279	32,461
North Dakota	10,117	4,577	9,441	5,361
Ohio	123,078	52,864	140,761	64,250
Oklahoma	23,630	16,081	14,565	16,786
Oregon	24,462	394	26,521	546
Pennsylvania	107,278	82,360	111,029	98,736
Rhode Island	5,956	6,871	11,640	6,821
South Carolina	8,063	13,675	7,918	12,558
South Dakota	11,826	9,987	9,747	10,222
Tennessee	21,081	38,552	19,811	33,082
Texas	41,244	109,779	40,454	102,601
Utah	10,723	2,894	11,800	1,204
Vermont	6,232	1,409	6,167	3,386
Virginia	46,673	12,030	43,737	20,803
Washington	55,278	2,169	62,607	1,471
West Virginia	71,466	34,921	124,412	29,987
Wisconsin	90,762	16,577	99,655	22,867
Wyoming	5,851	1,845	5,983	1,121
Undistributed [2]	259,936	109,504	311,651	284,542
Total shipments	2,330,042	1,759,242	2,539,597	2,009,579

[1] Subject to revision.

[2] Includes production of Puerto Rico (evaporated salt); exports to Australia, Canada, Central America, Cuba, Mexico, South America, and other countries; and shipments to unspecified destinations, including Alaska, Hawaii, and Puerto Rico.

Shipments of salt to noncontiguous territories, 1935–36, in short tons

Territory	1935		1936	
	Short tons	Value	Short tons	Value
Alaska	8,129	$132,690	9,841	$142,746
American Samoa	2	123	3	194
Guam	46	1,258	39	934
Hawaii	2,173	53,133	1,856	48,519
Puerto Rico	915	23,471	1,028	23,196
Virgin Islands	22	477	11	418
Wake Island			(1)	29
	11,287	211,152	12,778	216,036

(1) Less than 1 ton.

USES

Salt is employed for so large a variety of purposes and marketed so widely throughout the country that satisfactory figures have never been compiled of quantities used annually for even the most common uses. It is possible, however, to show salt production by methods of manufacture, as in the following table, and to quote estimates by uses.

Salt sold or used by producers in the United States, 1935–36, by methods of manufacture

Method of manufacture	1935		1936	
	Short tons	Value	Short tons	Value
Evaporated in open pans or grainers	466,327	$3,738,642	595,143	$4,352,907
Evaporated in vacuum pans	1,390,587	8,835,410	1,457,364	8,910,069
Solar evaporated	347,123	1,298,859	352,504	1,353,058
Pressed blocks from evaporated salt	126,005	900,040	134,586	965,114
Rock	1,734,551	5,354,411	1,975,090	5,780,190
Pressed blocks from rock salt	24,691	156,002	34,489	222,864
Salt in brine (sold or used as such)	3,837,613	1,554,547	4,279,760	1,721,975
	7,926,897	21,837,911	8,828,936	23,306,177

Salt brine used for chemicals and never reaching the market as dry salt comprised almost half of the total salt produced in 1936, as in the last few years. Of the estimated domestic distribution of chemical raw materials in the process industries, about two and two-thirds times as much salt was used as all other basic materials together.

The following estimate of salt consumption was extracted from a table on domestic distribution of chemical raw materials in the process industries.[1]

	Short tons		Short tons
Heavy chemicals	[illegible]	Soap and glycerine	40,000
Sugar and food products	1,200,000	Oils, fats, and greases	5,000
Leather, glue, and gelatines	350,000	Glass and ceramics	3,000
Dyes and organic chemicals	207,000	Other industries	1,405,000
Textile processing	40,000		

It is estimated that 85 percent of the total salt produced is used in process industries and 15 percent in other industries.

[1] Chemical and Metallurgical Engineering, Annual Review Number, February 1937, pp. 58–59.

Additional uses have been found for chlorine derived from salt, which formerly was unsalable in the market, and the estimate of its use by industries is as follows:

	Short tons		Short tons
Pulp and paper	145,000	Textile processing	11,000
Dyes and organic chemicals	80,000	Total for process industries	281,000
Heavy chemicals	45,000	Total for other industries	38,300

Of a total distribution of 319,300 short tons of chlorine 88 percent is used in process industries and 12 percent in other industries.

The trend in consumption of chemical processes that use raw-salt derivatives, based on 1929 as 100, was given for 1930–36 as follows:

Trends in salt-consuming industries, 1930–36 [1]

[1929=100]

	1930	1931	1932	1933	1934	1935	1936
Plate glass	70.32	57.75	34.69	58.14	60.69	119.41	130.00
Rayon	104.86	124.36	110.95	175.86	171.75	211.45	227.83
Leather	89.5	87.6	79.0	92.4	96.1	103.8	105.7
Wood pulp	95.6	89.8	77.1	89.2	93.3	100.3	119.0
Soap	98.0	95.8	92.8	87.3	89.5	91.5	98.0
Coal-tar dyes	77.62	74.95	63.95	90.59	78.24	91.49	95.14
Chlorine	92.96	90.95	92.96	107.54	150.76	160.30	180.9

[1] Chemical and Metallurgical Engineering, February 1937, p. 61.

Probably the greatest immediate growth of the salt industry will be expansion of chemical uses. The electrolysis of salt added many new outlets to the already multiple uses. In establishing electrolytic plants cheap electric current and availability of nearby markets are the principal factors to be considered if profitable business is to be developed.

MARKETING

Dry-salt price competition was keen the first part of 1936 but quieted down toward the end of the year. It was not apparent in the scheduled prices, which remained about the same, but special discounts, terms, and concessions said to exist made the actual prices vary widely.

An active subject of contention was the sale of industrial salt in bulk. The salt industry has tried for years to eliminate bulk sales of salt to resellers of the salt, preferring to sell bulk salt direct to consumers in carload lots only and packaged salt to resellers, as they often found themselves in competition with their own salt when jobbers to whom they had sold the salt in bulk packaged and sold it to consumers at lower prices than the producer sold to the consumer. In some sections of the United States no bulk salt is being shipped at present, and it appears that the question has not yet been settled satisfactorily.

FOREIGN TRADE

Exports of salt decreased 31 percent in quantity and 16 percent in value in 1936 compared with 1935. The main decrease was the 60-percent reduction in shipments to Japan, although substantial declines occurred also in shipments to Cuba and Canada. These three countries accounted for 91 percent of the salt exported in 1936 against 94 percent in 1935.

Imports of salt decreased slightly in 1936; smaller shipments from Spain and several less important sources were not quite balanced by larger imports from British West Indies and French Africa.

Salt imported into the United States, 1935–36, by countries

Country	1935		1936	
	Short tons	Value	Short tons	Value
North America:				
Canada	6,761	$16,049	4,200	$15,689
West Indies:				
British:				
Jamaica	13,570	22,133	17,400	26,705
Other British	114	1,150	2,710	4,382
Dominican Republic			410	890
French	20	194	67	297
Netherland	3,445	9,043	1,339	3,536
Europe:				
France			(1)	25
Germany	212	1,409	137	1,483
Netherlands	12	774	11	870
Spain	12,754	27,795	2,464	3,482
Sweden	1	91	1	91
United Kingdom	384	5,723	382	2,896
Africa:				
Algeria and Tunisia	9,940	18,628	18,111	39,248
Egypt	4,032	4,782	3,808	13,188
	51,245	107,771	51,040	112,782

[1] Less than 1 ton.

Salt exported from the United States, 1935–36, by countries

Country	1935		1936	
	Pounds	Value	Pounds	Value
North America:				
Bermuda	43,516	$623	74,338	$882
Canada	93,844,746	205,623	84,935,354	191,766
Central America:				
British Honduras	793,360	4,590	814,450	4,641
Costa Rica	32,188	312	28,462	445
Guatemala	323,383	2,154	149,642	967
Honduras	342,114	3,292	337,069	3,242
Nicaragua	586,603	5,697	434,577	3,969
Panama	1,275,023	14,489	1,351,105	14,251
Salvador	323	13	10,465	46
Mexico	5,241,587	34,987	5,549,136	41,774
Miquelon and St. Pierre Islands	90,374	235	1,056	21
Newfoundland and Labrador	68,692	500	106,455	551
West Indies:				
British:				
Jamaica	17,291	253	24,245	245
Other British	13,730	288	12,507	316
Cuba	25,417,165	121,540	18,419,798	97,099
Dominican Republic	348,186	5,522	449,684	8,205
Haiti	21,185	497	30,135	503
Netherland	166,311	1,968	118,957	1,784
South America:				
Argentina	12,560	370	1,260	35
Bolivia	457	16	1,693	86
Brazil	2,429	84	975	44
Chile	100	11		
Colombia	41,823	696	45,063	1,204
Guiana, British	1,100	110		
Paraguay	318	8	312	10
Peru	2,260	47	13	5
Uruguay	3,850	100	1,950	50
Venezuela			2,625	44

Salt exported from the United States, 1935–36, by countries—Continued

Country	1935		1936	
	Pounds	Value	Pounds	Value
Europe:				
Belgium	39	$1		
Denmark	1,950	62	1,950	$63
France	72	2		
Irish Free State	5,000	500	8,480	833
Italy	120	3		
Netherlands			1,000	10
Norway			29,280	554
Sweden	3,900	100		
Turkey	(1)	(1)	(1)	(1)
United Kingdom	22,600	308	23,900	299
Asia:				
British Malaya	1,242	92	1,073	25
Ceylon			352	35
China	18,444	1,114	15,738	746
Hong Kong	45,659	1,092	31,667	804
India, British	1,717	114	2,297	192
Indochina, French	416	20	100	4
Iraq			78	2
Japan	92,027,055	100,058	36,910,890	38,830
Kwantung	4,930	205	6,738	217
Netherland India	12,132	494	10,340	412
Palestine	4,726	107	11,340	227
Philippine Islands	361,740	6,920	452,412	7,078
Saudi Arabia	264	16	694	39
Siam	716	48	2,102	107
Syria			144	4
Turkey	58	2		
U. S. S. R. (Russia)			5,696	103
Other Asia	504	20	3,890	119
Africa:				
Belgian Congo	87	6		
British:				
East	2,248	65	3,620	118
Gold Coast	1,312	45	585	24
South (Union of)	28,605	354	15,686	421
Egypt	1,950	75		
Morocco	3,900	125	45,000	259
Portuguese:				
Mozambique			200	5
Other Portuguese	48	2		
Oceania:				
British:				
Australia	2,381,682	24,249	1,880,046	22,040
New Zealand	470,665	5,451	1,259,015	14,271
Other British	4,868	95	3,348	51
French	326,206	3,752	318,992	3,593
	224,425,029	549,522	153,947,979	463,670

[1] Included with Turkey in Asia.

WORLD PRODUCTION

The widespread production of salt among the nations of the world is shown in the following table.

World production of salt, 1931–35, in metric tons

[Compiled by M. T. Latus, of the Bureau of Mines]

Country [1]	1931	1932	1933	1934	1935
North America:					
Canada	231,885	237,025	262,546	293,960	324,975
Costa Rica	3,000	2,700	2,900	3,330	3,500
Cuba	22,680	31,751	35,000	20,964	36,921
Mexico	87,104	81,476	90,730	(2)	57,746
Nicaragua	(2)	(2)	28	----------	----------
Panama	1,035	6,000	2,604	4,947	5,541
United States:					
Rock salt	1,682,066	1,437,636	1,619,309	1,735,600	1,595,949
Other salt	4,993,028	4,375,549	5,279,769	5,169,921	5,595,173
West Indies:					
British:					
Bahamas [3]	12,447	254	2,865	3,175	545
Grenada (Windward Islands)	131	----------	----------	----------	----------
Leeward Islands [3]	2,353	771	35	1,357	(2)
Turks and Caicos Islands [3]	27,361	20,956	24,960	18,963	28,803
Netherland [3]	6,352	11,502	9,401	6,479	3,781
South America:					
Argentina [4]	159,372	181,138	205,568	194,443	(2)
Brazil	(2)	(2)	153,045	77,768	(2)
Chile	(2)	26,000	44,649	31,210	36,453
Colombia [5]	29,000	29,000	29,000	29,000	29,000
Ecuador:					
Rock salt	148	----------	109	114	119
Other salt	28,858	[5] 28,000	35,428	28,902	32,039
Peru	30,727	31,394	33,622	34,343	35,000
Venezuela	(2)	23,648	(2)	28,357	(2)
Europe:					
Austria:					
Rock salt	862	912	1,075	864	1,257
Other salt	122,612	170,570	140,669	163,732	198,209
Bulgaria:					
Rock salt	3,900	3,380	6,000	6,138	5,330
Other salt	40,568	24,040	14,000	48,722	36,629
Czechoslovakia	190,179	177,413	156,565	147,299	163,843
France:					
Rock salt and salt from springs	1,518,310	1,483,820	1,615,890	1,673,280	1,549,197
Other salt	389,340	166,760	513,250	398,070	348,505
Germany:					
Rock salt	2,086,884	2,115,688	1,841,276	2,024,194	2,077,322
Other salt	490,975	485,379	426,297	509,316	525,515
Greece	(2)	(2)	73,448	107,696	113,980
Italy:					
Rock salt	327,174	332,315	344,091	393,306	483,438
Other salt	759,249	599,810	709,413	576,742	669,362
Malta	859	880	838	1,572	838
Netherlands: Rock salt	[6] 56,141	[6] 60,765	[6] 64,949	74,759	70,963
Poland	561,089	491,508	449,492	506,383	515,094
Portugal [3]	17,010	55,049	55,315	56,511	81,965
Rumania: Rock salt	254,808	288,070	281,131	308,723	323,996
Spain:					
Rock salt	155,448	152,683	156,756	160.023	(2)
Other salt	733,860	806,518	772,460	602.308	(2)
Switzerland	87,727	82,692	80,348	81,596	79,757
U. S. S. R. (Russia) [7]	3,181,500	2,636,400	2,734,000	3,544,000	4,349,500
United Kingdom:					
Great Britain:					
Rock salt	18,134	17,156	19,835	17,650	16,571
Other salt	1,897,376	2,223,141	2,370,766	2,528,634	2,713,377
Ireland, Northern:					
Rock salt	3,764	2,725	2,107	3,533	3,282
Other salt	(2)	8,747	9,412	10,500	10,199
Yugoslavia	52,745	52,846	45,115	41,922	43,549
Asia:					
Ceylon	45,539	17,987	8,354	63,449	41,612
China [8]	(2)	3,120,000	3,170,000	3,220,000	(2)
Chosen	138,000	138,000	138,000	138,000	138,000
Cyprus [5]	3,000	3,000	3,000	3,000	3,000
India:					
British (including Aden):					
Rock salt	164,491	174,804	172,895	182,047	181,214
Other salt	1,704,431	1,466,911	1,566,986	1,813,172	1,798,227
Netherland	244,080	236,283	108,722	92,370	(2)
Portuguese [5]	12,000	12,000	12,000	12,000	12,000
Indochina	32,880	28,683	69,421	129	33,182
Iraq [9]	7,299	5,306	3,739	5,333	7,035
Japan:					
Japan proper [10]	521,125	572,497	630,837	676,302	604,323
Taiwan	199,049	122,110	191,935	191,577	(2)

See footnotes at end of table.

World production of salt, 1931–35, in metric tons—Continued

Country	1931	1932	1933	1934	1935
Asia—Continued					
Palestine					
Rock salt	1,259	979	878	859	867
Other salt	7,594	8,046	8,404	9,389	(2)
Philippine Islands	42,570	35,489	37,938	(2)	(2)
Siam	[11] 196,400	(2)	(2)	(2)	(2)
Syria [5]	10,000	10,000	10,000	10,000	10,000
Turkey [6]	100,000	100,000	100,000	100,000	100,000
U. S. S. R. (Russia)	(7)	(7)	(7)	(7)	(7)
Africa:					
Algeria	36,161	57,605	77,878	42,885	67,990
Belgian Congo [5]	80	80	80	80	80
Canary Islands [5]	2,000	2,000	2,000	2,000	2,000
Cape Verde Islands	11,075	(2)	(2)	(2)	(2)
Egypt [3]	102,873	142,097	136,426	288,470	256,851
Eritrea	80,000	128,000	92,497	(2)	(2)
Ethiopia: Rock salt	20,000	25,000	10,000	10,000	10,000
French West Africa	6,000	1,600	(2)	1,200	(2)
Kenya Colony	(2)	194	2,540	1,760	2,845
Libya (Italian Africa):					
Cyrenaica [5]	10,000	10,000	10,000	10,000	10,000
Tripolitania [3]	20,000	20,000	20,000	20,000	20,000
Mauritius [5]	1,500	1,500	1,500	1,500	1,500
Morocco, French	8,000	8,000	8,000	1,063	1,194
Nigeria [4]	400	400	400	400	400
Portuguese West Africa (Angola) [5]	25,000	25,000	25,000	25,000	25,000
Somaliland:					
British [5]	15,000	15,000	15,000	15,000	15,000
French	14,000	30,792	50,000	48,000	60,000
Italian	240,000	159,100	216,317	(2)	(2)
South-West Africa: Rock salt	1,093	2,102	3,144	2,800	5,624
Sudan, Anglo-Egyptian	11,437	(2)	(2)	24,421	26,960
Tanganyika Territory	6,845	6,255	7,325	7,418	6,916
Tunisia	(2)	(2)	86,511	86,966	79,689
Uganda	1,908	(2)	1,516	4,950	3,180
Union of South Africa	(2)	62,092	88,174	83,233	(2)
Oceania:					
Australia:					
South Australia	69,768	61,027	59,527	62,063	79,255
Victoria [5]	50,000	50,000	50,000	50,000	50,000
Western Australia [5]	4,001	2,815	(2)	2,713	(2)

[1] In addition to the countries listed salt is produced in Bolivia, Gold Coast, Madagascar, and Southern Rhodesia, but figures of production are not available.
[2] Data not available.
[3] Exports.
[4] Railway shipments.
[5] Estimated annual production.
[6] Sales.
[7] Output of U. S. S. R. in Asia included with U. S. S. R. in Europe.
[8] Includes Manchuria.
[9] Salt issued by the Government for sale.
[10] Year ended Mar. 31 of year following that stated. The figures do not include output from salt beds which, although situated on Government beach lands, have no fixed areas.
[11] Year ended Mar. 31 of year following that stated.

BROMINE

The figures for bromine production in this report comprise the quantity of bromine recovered by the producers from natural brines and the bromine content of bitterns used by producers in the manufacture of bromine compounds. The largest part of the bromine output reported is not sold as bromine but as ethylene dibromide, potassium and sodium bromide, and other bromine compounds. In 1936 the bromine produced amount to 20,609,025 pounds valued at $4,038,438, an increase of 25 percent in quantity and 16 percent in value over 1935.

Bromine and bromine in compounds sold or used by producers in the United States, 1932–36

Year	Pounds	Value	Year	Pounds	Value
1932	5,727,561	$1,182,569	1935	16,428,533	$3,483,239
1933	10,147,960	2,040,352	1936	20,609,025	4,038,438
1934	15,344,290	3,227,425			

The Ethyl-Dow Chemical Co., which began to extract bromine directly from sea water at Wilmington, N. C., in 1934, is the largest producer of bromine in the United States, and enlargement of the plant in 1936–37 is reported. Other companies that produce bromine are the California Chemical Co. (address, Newark), Chula Vista, Calif.; Michigan Chemical Corporation, St. Louis, Gratiot County, Mich.; Rademaker Chemical Corporation, Eastlake, Manistee County, Mich.; Morton Salt Co. (address, 208 West Washington St., Chicago, Ill.), Manistee, Mich.; the Dow Chemical Co., Midland, Mich.; Pomeroy Salt Corporation (address, Pomeroy, Ohio), Minersville, Ohio; Excelsior Salt Works, Inc., Pomeroy, Ohio (idle, 1936); Texaco Salt Products Co. (address, care of The Texas Co., Houston, Tex.), Tulsa Okla. (idle, 1936); J. Q. Dickinson & Co., Malden, W. Va.; Liverpool Salt Co., Hartford, W. Va.; Ohio River Salt Corporation, Mason, W. Va.; and Westvaco Chlorine Products, Inc., South Charleston, W. Va. It was reported that in 1936 a plant for the manufacture of bromine was under construction at Filer City, Manistee County, Mich., by the Great Lakes Chemical Corporation. No production was reported.

The figures for the value of bromine reported to the Bureau of Mines by the producers represent the value of the bromine f. o. b. plant or shipping point. The average unit value for 1936 was 20 cents a pound compared with 21 cents in 1935. According to Chemical and Metallurgical Engineering, the wholesale price per pound of bulk bromine quoted in the New York market from 1926 to February 1931 was 45 to 47 cents. The price quoted March 1931 and continuing through 1936 was 36 to 38 cents.

Foreign trade.—Imports of bromine, potassium bromide, and sodium bromide, which at one time represented the chief imports of bromine products, are at present only a small part of the total, the largest part being ethylene dibromide used in the manufacture of ethyl gasoline. Importations of ethylene dibromide have fluctuated greatly since 1928 when imports of 283,205 pounds were first reported separately. The largest importation was 3,024,484 pounds in 1930, but in 1933 the quantity had declined to 290,410 pounds. Imports increased to 477,005 pounds in 1935 and jumped to more than twice that quantity in 1936.

The following table shows bromine and bromine compounds imported for consumption in 1936, by countries.

Bromine and bromine compounds imported for consumption in the United States in 1936, by countries

Country	Bromine		Ammonium bromide		Ethylene dibromide		Potassium bromide		Sodium bromide		Other bromine compounds	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Germany	9	$10	2,202	$815	1,028,977	$173,899	36,897	$13,114	23,109	$6,417	7,933	$8,060
Gibraltar	----	----	------	------	224,994	37,077	------	------	------	------	------	------
Japan	18	30	------	------	------	------	------	------	------	------	------	------
Miquelon and St. Pierre Islands	----	----	------	------	------	------	------	------	------	------	641	2,305
Salvador	----	----	------	------	------	------	------	------	11,023	2,924	------	------
Switzerland	----	----	------	------	------	------	------	------	------	------	22,656	13,686
	27	40	2,202	815	1,253,971	210,976	36,897	13,114	34,132	9,341	31,230	24,051

CALCIUM CHLORIDE

The calcium chloride reported in the following table occurs as an original constituent of the natural brine produced in connection with the extraction of salt or salt and bromine from mineral raw materials only. A large output of calcium chloride made by manufacturing processes is not included. The material reported includes calcium chloride mixed with magnesium chlorides or other salts.

Production in 1936 was reported as 125,911 short tons valued at $1,909,908, an increase of 51 percent in quantity and 84 percent in value over 1935.

Producers of calcium chloride from natural brines in the United States are The California Rock Salt Co. (address, 2465 Hunter St., Los Angeles), Saltus, Calif.; The Dow Chemical Co., Midland, Mich.; Saginaw Salt Products Co., Saginaw, Mich. (idle 1936); Pomeroy Salt Corporation (address, Pomeroy, Ohio), Minersville, Ohio; Excelsior Salt Works, Inc., Pomeroy, Ohio (idle 1936); Texaco Salt Products Co., Tulsa, Okla. (idle 1936); J. Q. Dickinson & Co., Malden, W. Va.; Liverpool Salt Co., Hartford, W. Va.; Ohio River Salt Corporation, Mason, W. Va.; and Westvaco Chlorine Products, Inc., South Charleston, W. Va.

Calcium (calcium-magnesium) chloride from natural brines sold by producers in the United States, 1932–36

Year	Short tons	Value	Year	Short tons	Value
1932	66,286	$1,163,385	1935	83,546	$1,039,103
1933	57,813	893,442	1936	125,911	1,909,908
1934	76,719	1,153,159			

Calcium chloride imported for consumption in the United States, 1932–36

Year	Short tons	Value	Year	Short tons	Value
1932	3,569	$48,865	1935	2,004	$26,987
1933	3,583	48,115	1936	2,128	25,678
1934	1,975	26,271			

Calcium chloride exported from the United States, 1932–36

Year	Short tons	Value	Year	Short tons	Value
1932	17,747	$378,130	1935	30,736	$525,179
1933	15,710	312,309	1936	27,830	503,966
1934	30,715	566,189			

IODINE

Until 1932 little naturally occurring iodine had been produced commercially in the United States. During the war there was a small output of iodine from kelp at plants on the Pacific coast which are no longer active. Extensive experimental work during recent years on processes for the extraction of iodine from brines and oil-well waters has resulted in the establishment of three plants recovering iodine from oil-well brines in Los Angeles County, Calif. These plants were operated in 1936 by the Deepwater Chemical Co., Ltd., Compton, Calif.; the General Salt Co., Ltd., Long Beach, Calif. (sales from stock); and the Io-Dow Chemical Co., Midland, Mich.

Sales of domestic iodine in 1936 were 233,925 pounds valued at $212,635, a decrease of 5 percent in quantity and 14 percent in value. Imports, which have been held at least partly responsible for restricted production of domestic iodine, increased in 1936 following a sharp decline in 1935.

Iodine produced in the United States, 1932–36

Year	Pounds	Value
1932	173,953	$395,951
1933	401,525	669,289
1934	284,604	342,957
1935	245,696	248,654
1936	233,925	212,635

Iodine imported for consumption in the United States, 1932–36

Year	Crude		Resublimed		Year	Crude		Resublimed	
	Pounds	Value	Pounds	Value		Pounds	Value	Pounds	Value
1932	631,669	$2,225,661	100	$269	1935	375,819	$420,793		
1933	1,411,687	2,936,489	200	493	1936	592,217	558,326		
1934	1,481,123	2,134,979							

NATURAL SODIUM COMPOUNDS AND BORON MINERALS

By A. T. Coons

SUMMARY OUTLINE

In 1936 the production of natural sodium compounds (exclusive of sodium chloride) reached a new peak. The total output of sodium carbonates, sodium sulphates, and sodium borates during the year was 468,233 short tons, an increase of 16 percent over 1935. The value of the 1936 production totaled $7,599,046, a gain of 11 percent over the year preceding.

DOMESTIC PRODUCTION

The quantity and value of the natural sodium compounds (exclusive of common salt) produced in each year from 1932 to 1936 are given in the following table.

Natural sodium compounds (other than NaCl) sold or used by producers in the United States—1932–36

Year	Carbonates [1]		Sulphates [2]		Borates [3]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1932	55, 377	$888, 052	32, 204	$210, 342	181, 915	$3, 023, 844	269, 496	$4, 122, 238
1933	70, 461	918, 295	46, 539	245, 240	188, 047	3, 436, 377	305, 047	4, 599, 912
1934	88, 325	1, 254, 113	16, 650	148, 225	242, 500	4, 822, 014	347, 475	6, 224, 352
1935	93, 230	1, 173, 003	38, 706	[4] 275, 943	272, 967	5, 381, 560	404, 903	[4] 6,830,506
1936	102, 866	1, 106, 364	51, 608	336, 559	313, 759	6, 156, 123	468, 233	7, 599, 046

[1] Soda ash, bicarbonate, sesquicarbonate, and trona.
[2] Salt cake and Glauber's salt.
[3] 1932–33: Borax, kernite, and boric acid (calculated as borax); 1934–36: Borax, kernite, and boric acid (calculated as borax) and also includes a small quanity of colemanite.
[4] Revised figures.

Prior to 1927 sodium carbonates constituted the bulk of the natural product, but with the introduction of kernite (rasorite) sodium borate became the principal natural sodium compound produced.

Sodium carbonates and sodium sulphates.—In 1936 the sales of sodium carbonates amounted to 102,866 short tons valued at $1,106,364, an increase of 10 percent in quantity but a decrease of 6 percent in value. The output of sulphates, used as salt cake in the manufacture of glass,

paper, and other commodities, and as Glauber's salt, used chiefly in the preparation of mineral foods for cattle, increased 33 percent in quantity and 22 percent in value compared with 1935. This salt has fluctuated more in annual output than the other sodium salts, producers reporting the imported crude salt (not dutiable), as the principal obstacle to the advancement of the domestic product. A report recently issued by the Bureau of Mines describes a process of obtaining anhydrous sulphate from saline deposits or brines.[1]

Figure 118 gives the quantity and value of natural sodium compounds produced in the United States, 1927–36.

Boron minerals.—The output of boron minerals reached a new peak in 1936. Reports of producers to the Bureau of Mines indicate that the total production during the year amounted to 313,759 short tons valued at $6,156,123, increases of 15 percent in quantity and 14 percent in value over 1935. Before 1927 the source of all the borax except that

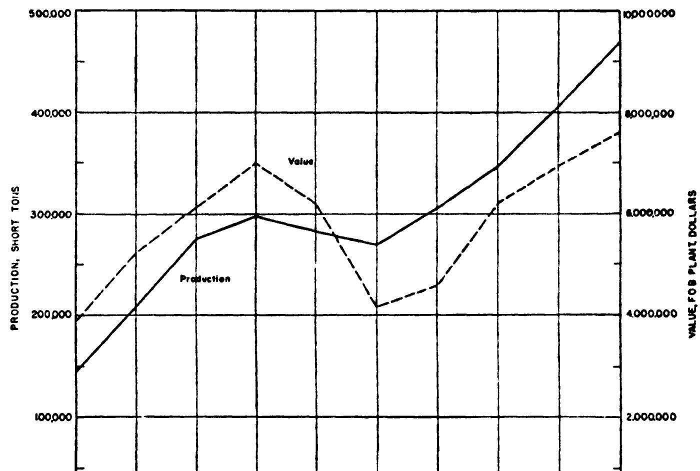


FIGURE 118.—Quantity and value of natural sodium compounds (other than NaCl) produced in the United States, 1927–36.

made at Searles Lake and Owens Lake was colemanite (calcium borate) mined in California and Nevada. In 1927 kernite mined in Kern County, Calif., replaced colemanite, production of which virtually ceased after 1927, although small shipments were made through 1930, and small shipments (included with borates) have been made in 1934, 1935, and 1936.

Manufactured compounds.—Besides these products of natural brines, a large output of soda ash made by the ammonia-soda process and a small quantity of electrolytic soda is manufactured from common salt brine. In 1935, according to the Bureau of the Census, 17 establishments produced 2,508,559 short tons of soda ash. Of the total, 637,224 tons were consumed by the producing establishments, and 1,871,335 tons valued at $28,424,750, were sold.

[1] Conley, J. E., and Partridge, Everett P., Anhydrous Sodium Sulphate from Saline Deposits or Brines by a Four-Stage Process: Report of Investigations 3299, Bureau of Mines, 1936, 18 pp.

In the same way, natural sodium sulphates account for a relatively small part of the total domestic production, most of which is recovered at chemical works. Compared with a total output of natural sodium sulphate of 38,706 short tons valued at $275,943 in 1935, the Bureau of the Census reports the production of 169,197 tons of salt cake valued at $1,857,435; 27,933 tons of niter cake (of which 9,348 tons was consumed in the establishment and 18,585 tons valued at $342,132 was sold; 23,609 tons of refined anhydrous sodium sulphate valued at $457,890; and 40,735 tons of Glauber's salt valued at $549,220. The aggregate value of these items is $3,206,677.

REVIEW OF OPERATIONS

In 1936 most of the material included in the sales of sodium carbonate was soda ash—normal sodium carbonate (Na_2CO_3)—produced in California from the waters of Owens Lake in Inyo County by the Natural Soda Products Co. at Keeler, and from the waters of Searles Lake in San Bernardino County by the American Potash & Chemical Co. at Trona and the West End Chemical Co. at Westend. Sodium bicarbonate ($NaHCO_3$) and trona, a mixture of soda ash and bicarbonate, were produced by the Natural Soda Products Co., and bicarbonate and sesquicarbonate were reported by the Pacific Alkali Co. at Bartlett.

Sodium sulphate, as salt cake (Na_2SO_4), was produced at Trona on Searles Lake, San Bernardino County, Calif., by the American Potash & Chemical Co. in 1936 for the third year. Production at this plant largely accounts for the continued increase in the output of this salt. A considerable quantity was also produced near Monahans, Ward County, Tex., by the Ozark Chemical Co., of Tulsa, Okla., and sales were made from stock on hand at the deposit of the Rhodes Alkali & Chemical Corporation near Mina, Mineral County, Nev. A plant for the production of natural sodium compounds was in the process of erection in 1936 near Wilson Creek, Grant County, Wash., by the Sodium Products Co., but no product has been marketed. The Salt Lake Sodium Products Co., Salt Lake City, Utah, had under construction at Saltair, Salt Lake County, a plant for the production of Glauber's salt and anhydrous sodium sulphate. Hydrated sodium sulphate ($Na_2SO_4.10H_2O$) (Glauber's salt) was produced near Casper, Natrona County, Wyo., by W. E. Pratt on the Pratt and Gill deposits. The Iowa Soda Products Co. mined Glauber's salt near Rawlins, Carbon County, Wyo.

The sodium borate produced in 1936 includes borax ($Na_2B_4O_7.10H_2O$) obtained in California from Searles Lake brines in San Bernardino County by the American Potash & Chemical Co. at Trona and the West End Chemical Co. at Westend and from Owens Lake brines in Inyo County by the Pacific Alkali Co. at Bartlett. Sodium borate, as kernite ($Na_2B_4O_7.4H_2O$), was produced in Kern County, Calif., by the Pacific Coast Borax Co. near Mojave. Boric acid also was produced by the American Potash & Chemical Co.; this product, calculated as borax, is included with sodium borate in the figures for sales from 1932 to 1936. Colemanite (calcium borate) was produced in small quantity near Shoshone, Inyo County, by the United States Borax Co.

SALES BY CONSUMING INDUSTRIES

A recent analysis made by Chemical and Metallurgical Engineering [2] indicates that in 1936 more than a third (38 percent) of the soda-ash sales were made to producers of heavy chemicals and manufacturers of dyes and organic chemicals. The glass and ceramic industries accounted for another 38 percent of the total sales. Other important consumers of soda ash were the soap and glycerine manufacturers, the textile-processing mills, and the pulp and paper industry.

Three industries—pulp and paper, textile processing, and glass and ceramics—absorbed more than 86 percent of the sales of sodium sulphates in 1936.

The following table gives the percentage distribution of sales of soda ash and sodium sulphates in 1936, as estimated by Chemical and Metallurgical Engineering.

Estimated distribution of sales of soda ash and sodium sulphates in 1936, by consuming industries

Industry	Soda ash (percent)	Sodium sulphates (percent)
Heavy chemicals	27.4	2.5
Dyes and organic chemicals	10.9	2.5
Glass and ceramics	38.3	10.2
Explosives	.2	
Leather, glue, and gelatin	.1	.2
Pulp and paper	4.4	56.0
Petroleum refining	.4	
Rayon and cellulose film	.1	1.2
Soap and glycerine	9.3	.5
Textile processing	2.7	19.9
Other process industries [1]	.6	
All other industries	5.6	7.0
	100.0	100.0

[1] Includes plastics and resins, wood chemicals and naval stores, manufactured gas and coke, oils, fats, and greases, paints and pigments, rubber goods, and sugar and food products.

FOREIGN TRADE [3]

Exports and imports of sodium sulphate and borax are given in the following tables; figures for sodium carbonates are not given, as they are relatively insignificant in comparison with domestic sales and consist wholly of manufactured salts.

Exports of sodium sulphate were small in 1933–36 and were not reported separately. The total imports of sodium sulphate in 1936 were nearly one and one-half times more than in 1935. Crude salt cake imported increased 37 percent in quantity and 39 percent in value; crystallized sodium sulphate (Glauber's salt) increased 4 percent in quantity and 3 percent in value; and the anhydrous salt increased 105 percent in quantity and 98 percent in value.

Exports of sodium borate decreased 11 percent in quantity and 4 percent in value, and the quantity of sodium borate imported was two and one-half times more than in 1935.

[2] Chemical and Metallurgical Engineering, vol. 44, no. 2, February 1937.
[3] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Sodium sulphate exported from the United States, 1929–36

Year	Short tons	Value	Year	Short tons	Value
1929	1,666	$53,176	1932	1,435	$24,155
1930	4,436	113,253	1933–36	(1)	(1)
1931	4,652	75,784			

[1] Not separately classified.

Sodium sulphate imported into the United States, 1935–36, by countries

Country	Crude (salt cake)		Crystallized (Glauber's salt)		Anhydrous		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1935								
Belgium	23,433	$181,820					23,433	$181,820
Canada	906	8,305					906	8,305
Chile	1,353	9,912					1,353	9,912
Germany	83,061	739,314	551	$4,479	5,760	$113,108	89,372	856,901
Netherlands	1,122	10,190			28	599	1,150	10,789
Sweden					(1)	64	(1)	64
U. S. S. R. (Russia)	504	9,900					504	9,900
	110,379	959,441	551	4,479	5,788	113,771	116,718	1,077,691
1936								
Belgium	21,078	163,789			22	344	21,100	164,133
Canada	6,589	46,072					6,589	46,072
Chile	686	4,912					686	4,912
Germany	119,766	1,094,461	574	4,595	11,700	222,263	132,040	1,321,319
Netherlands	3,301	24,591			132	2,951	3,433	27,542
Sweden			1	25	(1)	55	1	80
	151,420	1,333,825	575	4,620	11,854	225,613	163,849	1,564,058

[1] Less than 1 ton.

Imports of sodium sulphate from Germany, which represented 81 percent of the total imported in 1936, increased 48 percent compared with 1935. Imports of this commodity from Canada, although relatively small, were over seven times more than in 1935, and those from Netherlands nearly three times more. Imports from Belgium and Chile, on the other hand, decreased. In 1934 and 1935 there were imports of sodium sulphate from U. S. S. R. (Russia), but none was reported for 1936. By far the bulk of the imported salt cake is entered at Gulf ports for use by the growing kraft-paper industry of the South.

Crude sodium sulphate (salt cake) imported into the United States, 1935–36, by customs districts, in short tons

Customs district	1935	1936	Customs district	1935	1936
Atlantic ports:			Pacific ports and Canadian border:		
Georgia		6,015	Dakota	906	4,974
Maine and New Hampshire		645	Duluth and Superior		1,615
Maryland	4,872	3,192	Oregon	2,601	1,528
New York	1,297	731	San Francisco		55
Gulf ports:			Washington	4,592	3,433
Florida	18,773	28,506			
Mobile	47,952	81,237		110,379	151,530
New Orleans	22,803	14,579			
Sabine	6,583	5,020			

Sodium borate (borax) exported from the United States, 1932–36

Year	Short tons	Value	Year	Short tons	Value
1932	89,641	$2,677,626	1935	114,447	$3,242,350
1933	87,677	2,498,035	1936	102,021	3,119,850
1934	103,643	2,907,276			

Sodium borates imported for consumption in the United States, 1932–36

Year	Crude		Refined		Year	Crude		Refined	
	Short tons	Value	Pounds	Value		Short tons	Value	Pounds	Value
1932	--------	--------	610	$128	1935	--------	--------	748	$181
1933	1,069	$30,742	1,061	259	1936	--------	--------	1,887	457
1934	--------	--------	335	74					

GEM STONES

By Sydney H. Ball

SUMMARY OUTLINE

The jewelry industry throughout the world improved markedly in 1936, but retail sales in the United States, estimated at $310,000,000, were only 58 percent of those in 1929. Prices advanced in the latter half of the year owing to the increase in prices of fine gems and platinum. Improved financial conditions stimulated sales of fine jewelry in 1936, which comprised a larger proportion of total sales than in 1935.

If the demand for fine-colored stones continues, increased production will be necessary to avoid a shortage. During the year a number of exceptionally fine jewels were exhibited in the larger cities throughout the country, thereby increasing the interest of the public in gems.

Fashions in jewels.—Women's gowns in 1936 were of fine fabrics and required real gems as well as other luxurious accessories. The fashionable world has become "jewel-minded", and even with sport clothes, jewels are considered smart. For more than a year the use of gold has been increasing at the expense of platinum. Bracelets, clips, necklaces, and earrings have been particularly popular, the last frequently being clips covering the lobe of the ear. Jeweled flowers in the form of pins are both beautiful and expensive. Diamond, emerald, sapphire, and ruby are of course the most desired of all gems; however, star sapphire and aquamarine are gaining in popularity, as are also, to a smaller extent, topaz, amethyst, and turquoise. Men continue to favor star sapphire, cat's-eye, and star ruby.

Domestic production.—The search for precious stones in the United States in 1936 was more actively pursued than in the past 5 or 6 years, and the total value of products probably approached $12,500. Lee F. Hand is reported to have produced 545 pounds of turquoise worth about $4,500 from the Snow Storm claim, Royston district, Nevada. The Mildred and Marguerite properties in the Crow Springs district and the Reik mine near Columbus, Nev., as well as properties in Mineral Park, Ariz., are also reported to have produced turquoise. Some 10 tons of moss and other agate were collected in Montana, and agate and jasper were produced in California. A considerable amount of agatized wood was recovered from private lands around the Petrified Forest National Monument, Ariz., and some 3,250 pounds of irides-

cent obsidian was produced in Modoc County, Calif. About 800 pounds of rose quartz of gem quality was mined in the Black Hills of South Dakota. Walter W. Bradley reports that a diamond weighing ¾ carat was recovered in Butte County, Calif. In addition, the following gem stones were produced during the year: Ruby (Tiger, Ga.); sapphire (Macon County, Ga., and Montana); aquamarine (Park County, Colo.); opal (Nevada and San Bernardino County, Calif.); topaz (Thomas Range, Juab County, Utah, and Fresno County, Calif.), and blue topaz (Teller and Park Counties, Colo.); garnet (Fresno County, Calif., Emerald Creek 12 miles southwest of Fernwood, Idaho; Thomas Range, Juab County, Utah; Montana; Colorado; Black Hills, South Dakota, and North Carolina (rhodolite)); zircon (Fresno County, Calif.); prase opal (Sonoma County, Calif.); amazonite (Florissant district, Colorado); amethyst (Lorimer County, Colo.); and rock crystal (Arkansas).

Imports.—According to the Bureau of Foreign and Domestic Commerce imports of precious and imitation stones into the United States in 1936 totaled $38,146,113, an increase of 38 percent over 1935. Details are shown in the following tabulation:

	Carats	*Value*
Diamonds:		
Rough, uncut, duty free	97, 677	$6, 230, 902
Cut, but not set, dutiable	445, 610	22, 707, 703
Glaziers', engravers', and miners', not set, free	1, 166, 094	4, 328, 603
Pearls, not strung or set, dutiable	---------	743, 738
Other precious stones:		
Rough, uncut, free	---------	86, 490
Cut, but not set, dutiable	---------	2, 342, 358
Imitation, except opaque, dutiable	---------	1, 634, 843
Imitation, opaque, including imitation pearls, dutiable	---------	38, 708
Marcasites, dutiable	---------	32, 768

DIAMOND

With the United States and other countries again purchasing substantial quantities of stones, the diamond industry improved beyond expectations in 1936; virtually all indicators of the industry showed gains of 25 to 45 percent over 1935. The improvement was due largely to the better world industrial outlook and to a marked increase in demand for industrial stones, as industry now absorbs many stones that 20 years ago would have been cut as jewels. Speculation and investment buying were smaller factors in the increase. Notwithstanding a small increase in production, stocks of rough diamonds decreased markedly. Stocks of polished goods were also low. Prices of both rough and cut diamonds advanced during 1936.

Share dealings.—Trading in shares of diamond-mining companies was active, especially in the second half of 1936. Six representative stocks advanced an average of 86 percent during the year. At the end of the year they were 65 percent of their high (1927) and 650 percent of their low (1932). Of the 15 more important stocks, 11 paid dividends.

Market.—The value of sales of rough diamonds by the Diamond Trading Co. was about £8,500,000 in 1936, a 36-percent gain over 1935. The market was broad; purchasers came from all parts of the world, and all types of stones were sold. Good-quality large stones were scarce at the end of the year.

The market for polished stones was animated, and in the last half of 1936 even the cutters of small diamonds were making reasonable profits. India and the United States were the principal buyers, while Japan's 1936 purchases were more than tenfold those of 1934. Investment buying of fine stones of more than 1 carat was world-wide; the Continent was a particularly large purchaser.

Cutting.—The status of the diamond-cutting industry improved markedly in 1936, and the cutting centers of Belgium, Holland, and Germany showed a more conciliatory attitude toward one another. Better prices permitted the masters to make profits, employment increased, and the men enjoyed better wages and shorter hours. At the end of the year about 310 cutters were employed in the United States.

Imports.—Diamond imports into the United States in 1936, by countries, were as follows:

Diamonds imported into the United States in 1936, by countries [1]

Country	Rough, or uncut			Cut, but not set		
	Carats	Value		Carats	Value	
		Total	Per carat		Total	Per carat
Africa, British:						
Union of South	4,417	$310,975	$70.40	266	$30,815	$115.85
Other British	65	7,030	108.15			
Belgium	47,112	3,084,798	65.48	329,520	16,583,968	50.33
Brazil	471	11,954	25.38			
British Malaya				13	943	72.54
Canada	418	27,608	66.05	364	25,790	70.85
Czechoslovakia				165	10,990	66.61
Finland				1	60	60.00
France	79	2,398	30.35	3,619	244,769	67.63
Germany				97	5,430	55.98
Hungary				177	9,047	51.11
Japan	70	5,430	77.57			
Mexico	132	9,022	68.35			
Netherlands	23,245	1,376,986	59.24	109,349	5,627,199	51.46
Switzerland				10	3,743	374.30
United Kingdom	21,668	1,394,701	64.37	2,029	164,949	81.30
	97,677	6,230,902	63.79	445,610	22,707,703	50.96

[1] Compiled from records of the Bureau of Foreign and Domestic Commerce.

Taxes and tariffs.—On June 22, 1936, the 10-percent excise tax on sales of jewelry items valued at more than $25 was repealed. In September Italy placed a "temporary" duty of 20 percent on diamond imports.

World production.—World production of diamonds in 1936 approximated 8,296,900 carats (1.829 tons) worth about $35,600,000. Compared to 1935 this is an increase of about 9 percent in quantity and 14 percent in value. As the South African pipe mines operated only on a small scale, the alluvial mines accounted for some 96 percent of the carats and 86 percent of the value.

The following table gives, as accurately as available statistics permit, world diamond production for the past 5 years:

World production of diamonds, 1932–36, by countries, in carats

Country	1932	1933	1934	1935	1936
Africa:					
Angola	367,334	373,623	452,963	481,615	580,000
Belgian Congo	3,990,069	1,975,450	3,331,360	3,812,023	[1] 4,800,000
French Africa					[1] 13,000
Gold Coast [2]	842,297	863,722	1,142,268	2,172,563	1,489,410
Sierra Leone	749	32,017	68,633	[1] 250,000	[1] 450,000
South-West Africa	17,944	2,674	4,126	128,464	184,873
Tanganyika	1,391	1,432	1,414	1,415	[3] 2,700
Union of South Africa:					
Mines	307,431	14,149	9,414	274,317	339,718
Alluvial	488,096	492,404	430,898	402,405	284,204
	[4] 798,382	506,553	440,312	676,722	623,922
Brazil	34,000	[1] 30,000	[1] 30,000	[1] 50,000	[1] 100,000
British Guiana	61,780	48,569	44,569	46,564	[1] 47,000
Miscellaneous [5]	3,725	1,825	4,000	3,500	6,000
	6,117,671	3,835,865	5,519,645	7,622,866	8,296,905

[1] Estimated.
[2] Exports year ended Mar. 31.
[3] Exports.
[4] Includes a small quantity of diamonds recovered from re-treatment of tailings.
[5] 1932–34, includes Borneo, India, New South Wales, and, in certain years, French Equatorial Africa, Rhodesia, United States (Arkansas and California), and Venezuela; 1935, Australia, Borneo, French West Africa, India, Nigeria, and Venezuela; 1936, Borneo, India, Nigeria, Rhodesia, and Venezuela.

The increase in production in 1936 came from the pipe mines of South Africa and the alluvial mines of the Belgian Congo, Angola, and Sierra Leone, that is, from mines administered by interests closely allied to the Diamond Corporation. The Central African field (Belgian Congo-Angola), which for 6 years has been the largest producer by weight, in 1936 for the first time surpassed South Africa in value of production as well. French Africa made its initial appearance as a producer of some importance, whereas the production of the South African alluvial fields continued to decrease. Less than 40 percent of the total production was of gem quality; the increase was in industrial stones.

Industrial diamonds.—The rapid development of the use of hard alloys in industry in general and particularly in armaments programs has caused a great expansion in the use of abrasive diamonds. The United States, Great Britain, Germany, and Russia are the principal consumers. The chief use is trueing abrasive wheels, but diamond drills, diamond dies, wheels in which diamond or diamond dust are bonded in either bakelite or metal, diamond-set tools, diamond-bonded tools, and many other uses are also important. Some years ago bort largely supplanted carbonado in most drilling, but recently both types of diamonds have been set in some bits. Some bitmakers are now molding bits, the diamonds being "set" in molten metal. The use of "common goods" (cheaper than bort) in diamond drilling is increasing. Experiments continue to supplant rock drills with diamond drills in driving drifts, and diamond drills are used in stoping at the Noranda mine. On the Rand experiments are being conducted with a diamond-impregnated wheel built on the principle of a coal cutter, with which the "banket" is sliced.

It should be emphasized that 50 to 60 percent of a normal year's production of abrasive diamonds is destroyed in use in various industries.

The trade obtains industrial diamonds from three principal sources: (1) Direct from the Diamond Trading Co. or its affiliates; (2) from that part of cutters' and brokers' purchases from the company not suitable for gem stones or too "knotty" to cut easily; and (3) from "outside" sources, notably the Brazilian carbonado production. At present the Diamond Trading Co. is a more important source of industrial stones than formerly due to two factors: First, many stones once used in low-priced jewelry are now used industrially; and, second, carbonados now make up a smaller part of the total supply of industrial diamonds than a decade ago. Bahia's exports of carbonados in 1935 approximated 21,000 carats valued at $630,000 (in 1934, about 14,200 carats valued at $300,000).

Because of the greatly increased demand and the fact that most of the South African pipe mines have been shut down and that the Brazilian carbonado production has been subnormal, there has already been a shortage in supply of certain types of industrial stones. As a result of this scarcity some industrial diamonds were selling at pre-depression prices in 1936. Large industrial stones (over 2 carats) were, however, somewhat cheaper than in 1929, and carbonado was much cheaper. The price of crushing bort, notwithstanding increased use, remained steady.

Imports of industrial diamonds into the United States during the past 5 years are as follows:

Industrial diamonds (glaziers', engravers', and miners') imported into the United States, 1932–36 [1]

Year	Carats	Value		Year	Carats	Value	
		Total	Per carat			Total	Per carat
1932	163, 704	$1, 061, 823	$6. 49	1935	954, 589	$4, 293, 611	$4. 50
1933	263, 484	1, 263, 156	4. 79	1936	1, 165, 894	4, 328, 429	3. 71
1934	526, 007	2, 862, 349	5. 44				

[1] Compiled from records of the Bureau of Foreign and Domestic Commerce.

EMERALD, RUBY, AND SAPPHIRE

The Colombian Government abandoned the Muzo emerald mine about 5 years ago and in 1932 opened a new mine 3 miles distant. For the past 3 years the average annual production is said to have been about 400,000 carats worth 400,000 pesos. Some 300 workmen and a guard of 60 to 100 soldiers are employed. A few emeralds are recovered from the beryl pegmatites and surrounding schists near Gravelotte, northeastern Transvaal. Sales in 1935 were 148,451 carats worth £10,756.

Burma increased its ruby production considerably in 1935. The total output was 105,484 carats worth 114,063 rupees (in 1934, 21,622 carats); 2,431 carats of sapphires and 6,687 carats of spinels were produced as byproducts.

The Padar district of Kashmir, where operations at the sapphire mines were resumed in 1933, produced about 800,000 carats in 1935 compared with 1,075,000 carats in 1934. The total Indian output in 1935 was 904,571 carats. Ceylon's production of precious stones (largely sapphire) is apparently increasing; some estimates place it as high as Rs.2,000,000 in 1935. The Ratnapura, Matara, and Kandy

districts were especially active. Sapphire and beryl were recently discovered in abundance in the last two districts named. For some years the American Gem Mining Syndicate has operated its mine near Philipsburg, Mont., for industrial sapphires only. Production in 1936 was 17,200 ounces worth about $25,000. Sapphire was the only gem produced in Queensland in 1935, and sales totaled £1,804 15s. compared with £3,055 in 1934. The mine is at Sapphire. The Belgian Congo sapphire mines of the Minière des Grands Lacs have not been worked for several years.

LESSER GEMS

In 1935 Prussia produced 102,489 kilos of amber and purchased 9,484 kilos from small producers (in 1934, 107,026 and 9,165 kilos, respectively); 22,900 kilos valued at 258,000 RM were exported in 1935, or the highest exports since 1931. Most of the amber output was used industrially. In 1935 Burma produced 18.57 cwt. of amber valued by the Government at $777 and 1,264.75 cwt. of jadeite valued at $71,465. Meerschaum mining at Eskisehir, Asia Minor, has been encouraged by the Eti-Bank in connection with the Turkish 5-year plan. In pre-war days about 280 metric tons a year were exported, but less than 28 tons were shipped in 1935. Ninety percent of the output is exported. In 1935, 9,000 pounds of tiger-eye were exported from South Africa. The lighter-colored varieties occur in slabs 9 to 12 inches long, but the darker-colored only in smaller pieces. Brazil produces six types of quartz, of which 90 percent comes from Minas Geraes, and exports of rock crystal have averaged 5 tons yearly for the past 7 years. The United States and Japan are the principal consumers. In 1935, 230,862 kilograms valued at 998,701 paper milreis were exported. Madagascar continues to export much low-priced gem material to France, Japan, the Netherlands, Great Britain, and Czechoslovakia. In addition to 20,000 carats of precious stones about 1½ tons of garnet, amethyst, beryl, optical rock crystal, rose quartz, and chalcedony were exported in 1935. South-West Africa in 1935 exported gems other than diamonds valued at £1,818 to Germany. The mandated area is a source of aquamarine and heliodore, red and green tourmaline, topaz, and almandine garnet.

BIBLIOGRAPHY

Ball, Sydney H. Recent Developments in the Industrial Diamond Trade. Min. Jour. (London), Sept. 26, 1936.

——— The Diamond Industry in 1936. Jewelers-Circ., May and June, 1937.

Brown, J. Coggin. India's Mineral Wealth. Oxford Univ. Press, London.

Hohlbaum, Rudolf. Glass for Imitation Gems. Glasshütte, vol. 56, no. 27, 1935, pp. 407–409; no. 28, pp. 420–422; no. 29, pp. 435–437; no. 30, pp. 456–457; no. 31, pp. 469–471; no. 34, pp. 531–533. Ceram. Abs., vol. 15, no. 2, 1936, pp. 58–59.

Junner, N. R. Diamond Fields of the Gold Coast. Congres Internat. Mines, Metal., et. Geol. Appliq., 7th sess., Paris, 1935, p. 179–185.

Nott, Stanley. Chinese Jade, Its Characteristics, Folklore, and Symbolism. London.

Polinard, Edmond. Les gites minièrs d'eluvions et d'alluvions au Congo Belge: Leur prospection et leur exploitation. Revue Universelle des Mines, 8th ser., t. 13, no. 3, March 1937.

Spencer, L. J. A Key to Precious Stones. Blackie & Son, Ltd., London.

Whitlock, Herbert P. The Story of the Gems. Lee Furman, Inc., New York.

Wild, Georg O. Praktikum des Edelsteinkunde. Franckl, Stuttgart.

Willemse, A. De Edelsteenan (Precious Stones). C. van Hoof, Ekeren, Holland, 1936.

MINOR NONMETALS: GRAPHITE, GREENSAND, KYANITE, LITHIUM MINERALS, MINERAL WOOL, MONAZITE, OLIVINE, STRONTIUM MINERALS, AND VERMICULITE

By PAUL M. TYLER [1]

SUMMARY OUTLINE

GRAPHITE

The graphite-mining industry in the United States remained virtually dormant in 1936. There was, however, a steady increase in consumption throughout the world. Domestic flake graphite is not wanted by crucible makers, and virtually the entire dry-battery market, formerly a profitable outlet for American producers of flake graphite, has been lost to manufactured graphite. Moreover, dry-battery sales have declined sharply owing to the almost Nation-wide use of light-socket power instead of dry batteries for radios. For most other uses manufactured graphite or imported graphites are either cheaper or better. The opinion is widely held that a domestic industry could be created on a substantial scale, provided leading consumers could be induced to make a real effort to readjust their manufacturing operations so as to use the domestic product, but the fact is that there never has been enough incentive for them to undertake the requisite research. Except perhaps in wartimes a variety of good-quality graphite has always been available in abundance abroad, and the price of this raw material ordinarily represents too small a proportion of the cost of making and selling graphite products to encourage domestic consumers to experiment with domestic material, even if they felt they could get it cheaper.

No output of crystalline graphite was reported to the Bureau of Mines in 1936 from the various graphite-producing areas of the United States, although some sales were made locally by the Crystal Graphite Co., Dillon, Mont. The Carson Black Lead Co., Oakland, Calif., mined amorphous graphite for paint from its mine at Carson, Nev.

Artificial graphite is manufactured principally by the Acheson Graphite Corporation (30 East 42d St., New York, N. Y.) at Niagara Falls, N. Y., but is also produced as a byproduct of the manufacture of silicon carbide. The Acheson Graphite Corporation is likewise the

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

leading manufacturer of graphitized electrodes, although these are produced at St. Marys, Pa., by several other concerns.

The Trade Agreement with France, effective June 15, 1936, reduced the duty on flake graphite from 1.65 cents a pound to 30 percent ad valorem with the proviso that the new rate should be not less than 0.825 cent nor more than 1.65 cents. The ad-valorem rates on carbons electrodes, and other graphite or carbon products under the Tariff Act of 1930 (par. 216) were reduced by one-third; the duty on small arc-light electrodes was cut from 60 to 40 percent and that on other products from 45 to 30 percent of the foreign market value.

Graphite imported for consumption in the United States, 1933–36, by kinds

Kind	1933		1934		1935		1936	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Amorphous:								
Artificial	711	$27,107	579	$22,591	1,916	$74,679	1,635	$63,804
Natural	5,999	90,786	10,469	235,592	14,477	302,646	20,160	344,499
Crystalline:								
Lump and chip	294	9,532	384	18,878	215	11,606	250	18,107
Dust	90	3,072	302	12,109	84	4,444	68	4,090
Flake	959	80,569	2,387	200,314	1,669	132,758	2,058	136,162
	8,053	211,066	14,121	489,484	18,361	526,133	24,171	566,662

Graphite (all kinds) imported into the United States, 1925–36, by countries

Country	1925–29 (average)		1932 (short tons)	1933 (short tons)	1934 (short tons)	1935 (short tons)	1936	
	Short tons	Value					Short tons	Value
Austria							(1)	$12
Canada	1,876	$108,599	828	946	1,814	3,331	3,401	131,792
Ceylon, including British India	6,261	415,051	1,756	2,050	3,741	4,438	5,123	169,146
Chosen, including Japan	1,270	22,144	1,314	1,542	1,950	1,141	1,592	19,454
Germany	46	4,710	94	121	368	229	216	13,744
Italy	203	5,439	25	135		59	163	3,171
Madagascar, including France	2,484	240,840	788	885	2,014	1,473	1,932	121,277
Mexico	6,290	51,694	2,203	2,332	4,162	7,684	11,743	107,860
Norway	3	459			72			
Switzerland	3	417					(1)	7
U. S. S. R. (Russia)	(1)	9		41		6		
United Kingdom	136	15,260	7	1	(1)	(1)	1	199
Other	69	4,846						
	18,641	869,468	7,015	8,053	14,121	18,361	24,171	566,662

[1] Less than 1 ton.

Graphite exported from the United States, 1932–36

Year	Short tons	Value	Year	Short tons	Value
1932 [1]	790	$173,486	1935 [1]	1,480	$234,334
1933 [1]	914	182,671	1936 [2]	816	114,847
1934 [1]	1,245	250,332			

[1] Graphite, crude, refined, and manufactures.
[2] Graphite, crude, refined, and blended.

Graphite is found in almost every country and is produced commercially in a score of countries; nevertheless 85 percent of the world supply comes from half a dozen countries. On the basis of tonnage alone, Czechoslovakia, Austria, Chosen, and Germany (Bavaria) have been the largest producers of graphite, but their product is chiefly of the amorphous variety and consequently not so valuable as that of Madagascar and Ceylon, which produce flake and vein graphite, respectively. However, amorphous graphite is used relatively more and for a greater variety of purposes in Europe than in the United States, where consumption is divided more or less evenly among crystalline, amorphous, and artificial graphites.

Conditions in leading foreign producing countries have been reviewed briefly in two previous volumes of the Minerals Yearbook. Among new developments it is of interest to record here an all-time record output in Mexico, which produced 10,732 short tons valued at $107,134 in 1936, topping the previous peak by almost 30 percent. Canada's Black Donald mine in Renfrew County, Ontario, also had a good year; the value of its output increased to $92,820 from $79,781 in 1935. Heretofore the product of this mine has been used mainly for lubricants and foundry purposes, but it is now being employed in pencil making, a market that at one time was supplied almost exclusively by producers of Mexican graphite.

World production of natural graphite, 1927–35, in metric tons

[Compiled by M. T. Latus]

Country	1927–31 (average)	1932	1933	1934	1935
Australia:					
New South Wales	24		30		30
Queensland					14
South Australia		71		6	
Austria	19,466	10,598	14,771	18,145	19,490
Brazil [1]	9		1		2
Canada	1,174	314	367	1,377	(2)
Ceylon [1]	11,266	6,198	9,711	11,755	14,131
Chosen	22,495	16,733	22,677	31,294	44,698
Czechoslovakia	22,697	922	122	3,503	1,870
France	563				(2)
Germany (Bavaria)	21,031	20,808	19,755	17,535	21,663
India, British	9	5		342	566
Italy	6,565	2,945	3,200	3,908	5,153
Japan	382	495	869	969	1,201
Madagascar [1]	11,959	2,100	3,600	9,400	8,046
Mexico	5,354	2,045	2,685	3,898	6,976
Morocco, French [1]	60	100	66	183	238
Norway	176	672	1,983	2,281	2,342
Sweden					69
Union of South Africa	51	49	59	64	66
U. S. S. R. (Russia)	[3] 4,550	32,100	19,200	45,700	83,700
United States:					
Amorphous	[4] 2,514	(5)	(5)	(5)	(5)
Crystalline	[6] 2,459	(5)	(5)	(5)	(5)

[1] Exports.
[2] Data not available.
[3] Average for 3 years only (1927–29); data for 1930–31 not available.
[4] Average for 4 years only (1927–30); data for 1931 not available.
[5] Bureau of Mines not at liberty to publish figures.
[6] Average for 3 years only (1927–29); Bureau of Mines not at liberty to publish figures for 1930–31.

As most graphite business is done by private negotiation it is difficult to report prices. The variety of grades and kinds adds to the difficulty. During 1936 the American market was steady, and prices remained virtually unchanged. Madagascar flake averaged a trifle under and Ceylon lump a trifle over 5 cents a pound, while amorphous grades ranged from $10 to $20 a short ton.

London market quotations likewise varied little from the 1935 levels. Through 1936 Madagascar flake, 85 to 90 percent, duty paid, usually ranged from £18 to £20 a long ton, although lifting occasionally to £21. Ceylon lump, 90 percent, began the year at £11 to £12 a long ton and after stiffening perceptibly stood at £11 to £13 a ton at the end of the year. In American currency the final quotations were equivalent to about 4.15 cents per pound for Madagascar flake and 2.65 cents per pound for the Ceylon product. The former figure includes the duty collected on imports into the United Kingdom from countries outside of the British Empire.

GREENSAND

The best grade of greensand, screened and bagged, has been quoted in Engineering and Mining Journal Metal and Mineral Markets at $20 per short ton, f. o. b. cars in New Jersey, in carload lots. Production, recently reported by five companies, consists mostly of processed material used for water softening. The quantities used for fertilizer have dwindled to insignificant proportions.

Greensand production in New Jersey, 1925–36

Year	Short tons	Value: Total	Value: Average per ton	Year	Short tons	Value: Total	Value: Average per ton
1925–29 (average)	12,515	$195,393	$15.61	1933	6,713	$206,985	$30.83
1930–34 (average)	8,858	206,995	23.37	1934	7,335	209,278	28.53
1931	8,252	196,327	23.79	1935	7,589	219,749	28.96
1932	9,231	201,173	21.79	1936	8,368	177,835	21.25

KYANITE

The domestic kyanite industry is still in the development stage, and for 1936 there is little to record beyond a steady expansion in demand and further improvement in concentrating technique. Statistics of production are not collected by the Bureau of Mines, but output in North Carolina and Georgia increased, and larger quantities were imported from India.

Operations of Celo Mines, Inc. (Burnsville, N. C.), a leading producer, were described by Mattson [2] and, in more detail, by Trauffer.[3] At this plant the concentrating process is a combination of magnetic separation, screening, and air tabling. Garnet concentrates are a byproduct, and the complexity of the ore is indicated by the fact that in a single hand specimen 26 different minerals have been identified with a microscope.

Wet concentration is employed in Georgia where, according to Smith, State geologist,[4] the Georgia-Carolina Minerals Corporation, in addition to its placer operations at Clarkesville, started in 1936 the recovery of kyanite, mica, and other products from partly weathered kyanite-mica schist at two places in Habersham County.

The principal market for Georgia kyanite is glassworks refractories, and the price, f. o. b. mines, has been about $30 a ton. North Carolina

[2] Mattson, V. L., Kyanite Operations of Celo Mines: Bull. Am. Ceram. Soc., vol. 15, no. 9, 1936, pp. 313–314.

[3] Trauffer, W. E., Materials Move by Gravity in Kyanite Plant on North Carolina Mountainside: Pit and Quarry, vol. 28, no. 9, 1936, pp. 44–48.

[4] Smith, R. W., The Kyanite Industry of Georgia: Am. Inst. Min. and Met. Eng., Tech. Pub. 742, 1936 11 pp.

kyanite has been used for various ceramic purposes, while the imported material has been used extensively in the manufacture of refractory brick. Some research has been directed toward utilizing the expansive property of kyanite to offset shrinkage of high-alumina refractories, and experimental results have been promising. Large increase in the use of kyanite, however, seems to be contingent upon lower prices, probably $15 a ton or less. With small-scale operations the cost is likely to be too high for the product to be sold at any such figure, but once an adequate market is assured large-scale operations can probably be developed to meet the requirement for low-priced material. One objection to flotation concentrates is that the brickmakers demand a large proportion of coarse material, but possibly this objection can be overcome by sintering the fine kyanite so as to make a suitable grog. Experiments with this end in view are being conducted at the Bureau of Mines station at New Brunswick, N. J.

LITHIUM MINERALS

Lithium is rather widely distributed in nature,[5] and nearly a dozen minerals contain lithium as a more or less essential constituent. Only three minerals, however, are recognized as industrially available sources of lithium, and none of these contains more than small percentages of the element. Amblygonite, $2LiF.Al_2O_3.P_2O_5$, the richest ore of lithium, theoretically contains only 10 percent lithia (Li_2O) and commercially only about 9 percent. Spodumene, $Li_2O.Al_2O_3.4SiO_2$, ordinarily contains less than 7 percent Li_2O and formerly, although mined by one company for its own use, was not easily salable; with increased demand for lithium, however, it promises soon to become the principal source. The theoretical formula of lepidolite, $3Li_2O.2K_2O.3Al_2O_3.12SiO_2.8F$, indicates a lithia content of more than 6 percent, but 4 percent is about the top limit for commercial shipments. All three minerals characteristically occur only in pegmatites. Amblygonite and spodumene both resemble ordinary feldspar in appearance, and lepidolite is one of the micas which occurs, however, as pink to purple scaly masses rather than in large sheets.

The uses of lithium metal and its salts are outlined briefly in the chapter on Minor Metals in this volume of Minerals Yearbook. Of chief interest is the growing use of lithium chloride in air conditioning. Nevertheless, lithiated waters and medicinal preparations still account for a relatively large part of the consumption, and the uses of the metal are not unimportant. Lithium hydroxide is used in Edison storage batteries, and some lithium salts may be used in pyrotechnics owing to the red coloration they impart to flame, although most red flares are produced by strontium compounds. Lepidolite has been used in making enamels and special glasses, and it is possible that spodumene may be used as a ceramic raw material after preliminary calcination to convert it into the beta form which does not expand greatly upon further heating.

Domestic supplies of amblygonite and spodumene have come principally from South Dakota, although small quantities have been mined in California. Spodumene also occurs in Maine and North Carolina, apparently in large amounts. Lepidolite was mined

[5] Strock, Lester W., The Distribution of Lithium in Rocks and Minerals as Revealed by Quantitative Spectrum Analysis: Am. Mineral., vol. 21, no. 12, 1936, p. 7.

extensively in California and New Mexico from 1920 to 1930. The output of lithium minerals in the United States reached a maximum of 11,696 tons valued at $173,002 in 1920, of which most was lepidolite. In 1930 only 1,797 tons valued at $56,327 were reported. After further declines in 1931 and 1932, for which years figures cannot be published, mining of both amblygonite and spodumene was resumed in the South Dakota field. Statistics covering the domestic production of lithium minerals for 1918 to 1928, inclusive, have been published in Bureau of Mines Information Circular 6215 on caesium, rubidium, and lithium. Available data for later years follow:

Lithium minerals produced and shipped in the United States, 1929–36

Year	Number of producers	Short tons	Value	Year	Number of producers	Short tons	Value
1929	2	(1)	(1)	1933	6	504	$12,997
1930	5	1,797	$56,327	1934	5	719	20,980
1931	2	(1)	(1)	1935	4	1,154	26,834
1932	2	(1)	(1)	1936	6	1,239	25,273

[1] Bureau of Mines not at liberty to publish figures.

The Bureau of Mines recently has worked actively toward creating a spodumene-mining industry in North Carolina. The disseminated deposits near Kings Mountain have been shown by Hess [6] to afford one of the world's principal sources of potential supply of lithium. Methods for concentrating this and similar material known to occur in other States have been investigated by Will H. Coghill at the Bureau's station at Rolla, Mo., and by O. C. Ralston at its New Brunswick (N. J.) station. At the latter station a novel method of concentration has been evolved [7] that is so simple it can be done by farmers with home-made equipment. The Southern Mining & Milling Co., Clarkesville, Ga., began mining this ore and proposed to install a furnace for beneficiating it in 1937.

Prices of amblygonite tended slightly upward in 1936. Although still quoted nominally at $34 to $35 per short ton f. o. b. South Dakota mines, actual sales were made at prices up to $40 a ton for 8- to 9-percent material. The price of spodumene is about $20 f. o. b. South Dakota mines, and $35 can probably be obtained for 7-percent material delivered at eastern consuming points. Lepidolite is quoted in Engineering and Mining Journal Metal and Mineral Markets at $20 to $25 per ton (basing point not stated). Sales of domestic lepidolite in 1936 were insignificant, and South African and Canadian deliveries likewise seem to have been quite small.

MINERAL WOOL

Production figures for mineral wool are not collected by the Bureau of Mines but have recently been published biennially by the Bureau of the Census, which reported a total value of $7,672,096 for the production of "mineral wool (other than asbestos) for building insulation" in 1935 compared with $1,714,171 in 1933, $2,873,230 in 1931, and $2,377,324 in 1929.

[6] Hess, Frank L., Lithium in North Carolina: Eng. and Min. Jour., vol. 137, no. 7, 1936, pp. 339–342.
[7] Fraas, Foster, and Ralston, O. C., Beneficiation of Spodumene by Decrepitation: Bureau of Mines Report of Investigations, 3336, February 1937, 13 pp.

Slag wool was made in Germany in 1870, and the rock-wool industry was established in Indiana by 1897, but the great growth of the industry has taken place within the last decade. In 1900 the reported production of mineral-wool products was 6,002 tons valued at $60,320 or about $10 a ton. Ten years later it had grown to 8,408 tons valued at $84,012. The census of manufactures for 1929 reports the value only of mineral-wool products as $2,377,324, which came from eight producers—two in Indiana and one each in California, Illinois, Michigan, New Jersey, Ohio, and Wisconsin. Since the decline in 1933 the industry has forged ahead with remarkable rapidity. Census figures for 1935 show 111,745 tons of rock wool valued at $3,357,526, 31,648 tons of slag wool valued at $1,184,946, and "other" wool (mostly glass wool) valued at $3,129,624. No figures are given on the tonnage of glass wool, but as this product is worth a great deal more per ton than ordinary rock or slag wool the data indicate an aggregate production of all kinds of mineral wool of less than 200,000 tons in 1935. Unofficial estimates indicate that the total output in 1936 increased to more than 400,000 tons, but this figure cannot be verified. However, it may be noted that the number of plants increased in 1936 (at least 50 plants and perhaps more are now engaged in making these products), and most plants were working nearly to capacity. The National Association of Rock and Slag Wool Industries serves the industry.

Roughly two-thirds of the domestic output of mineral wool is used for building insulation, and much of it is employed for insulating existing homes. Notwithstanding the rapid growth in production and the increased output of competitive materials, such as vermiculite, there is no indication at present of approaching saturation of the market for mineral wool. A recent canvass of architects by a leading journal[8] drew a 100-percent affirmative answer in favor of house insulation against heat and cold, even for relatively small one-family dwellings. All types of insulation—mineral wool, aluminum foil, and wallboards—were popular. Florida and Louisiana architects stressed the importance of insulation against sun heat. This survey tends to confirm the trend of mineral-wool manufacture. Another factor favoring greater use of insulating materials is air conditioning which, after making rapid progress in commercial buildings, is generally expected to work down into the residential field. So long as the American people have money to spend on making their homes comfortable, a growing increment of such expenditures will be available for the purchase of insulating materials.

In most tests mineral wool stands out as having the highest insulating value among materials in general use for house fill. In Minerals Yearbook, 1936 (p. 1067) a serious error was made in reporting the results of tests by the National Research Laboratories, Ottawa.[9] The real message of the tabulated figures was that rock wool is a far better insulator than asbestos or serpentine in any of the forms tested.

[8] Architectural Record, The Record Scans the Field: Vol. 81, no. 3, 1937, p. BT-11.

[9] Niven, C. D., The Thermal Conductivity of Sundry Materials: Canadian Jour. Research, vol. 13, no. 1, sec. A, July 1935, pp. 16-18.

In a recent Letter Circular (LC–471, June 9, 1936), the National Bureau of Standards, Washington, lists a number of publications [10] which contain specific information as to insulation problems.

MONAZITE

As the use of cerium alloys in sparking flints for gas and cigar lighters has increased greatly during the last decade or two, it has been thought that this might soon revive the demand for monazite, This is a vain hope, for, as noted in the discussion of rare earths in the Minor Metals chapter of this volume, accumulations of cerium residues at thorium-nitrate and gas-mantle works throughout the world are large enough to supply demands for three-quarters of a century at the present rate of consumption. The magnitude of these accumulations can be estimated only roughly, but the figures show that the total consumption of monazite since 1893, mostly for gas-mantle making, has been a little short of 100,000 tons, of which more than 30 percent was cerium oxide and nearly 30 percent more comprised lanthana, didymia, and other rare-earth oxides. Only a small fraction of this 60,000 tons of rare-earth oxides has been utilized by the gas-mantle and other consuming industries.

No domestic production of monazite has been reported since 1925, when 2,000 pounds were recovered as a joint product in Florida beach-sand operations for ilmenite and zircon. British India captured most of the monazite market more than 20 years ago, but with gas-mantle requirements scarcely 10 percent of their one-time volume world demand for monazite has dropped to only a fraction of its former level, which is indicated by the maximum production of 7,392 short tons in 1909. Although all the thorium nitrate needed for gas mantles today could be extracted from about 300 tons of good monazite, actual demand has not fallen quite as much as this might indicate. The mineral has other uses, most important of which apparently is the manufacture of flaming-arc carbons. Due to the vogue of light therapy and the increase in sales of heat-ray lamps for use in American homes, imports of monazite into the United States have expanded again during the last few years.

Monazite sand imported for consumption in the United States, 1932–36

Year	Short tons	Value	Year	Short tons	Value
1932	1,569	$48,639	1935	1,299	$51,495
1933	56	1,935	1936	607	25,324
1934	112	4,867			

[10] National Bureau of Standards, Thermal Insulation of Buildings: Circ. BS C376, 1929.
American Society of Heating and Ventilating Engineers, Guide, New York (annual).
American Society of Refrigerating Engineers, Refrigerating Data Book, New York.
American Society of Refrigerating Engineers, Insulation Committee, Heat Transmission of Insulating Materials: 1922 Rept. (revised to 1924).
Finck, J. L., Mechanism of Heat Flow in Fibrous Materials: Bureau of Standards Jour. Research, vol. 5, 1930, p. 973; RP 243. (Out of print.)
Department of Commerce, National Committee on Wood Utilization, House Insulating, Its Economies and Application: 19th Rept.
Department of Commerce, National Committee on Wood Utilization, Insulation on the Farm: 25th Rept.
Van Dusen, M. S., and Finck, J. L., Heat Transfer Through Building Walls: Bureau of Standards Jour. Research, vol. 6, 1931, p. 493; RP 291.
University of Minnesota, Engineering Experiment Station, Heat Transmission Through Building Materials: Bull. 8.
Heilman, R. H., Insulation of Superheated Steam Surfaces: Trans. Am. Inst. Chem. Engrs., vol. 16, pt. 2, 1924, p. 79.
McMillan, L. B., Heat Insulating Properties of Commerical Steam Pipe Coverings: Jour. Am. Soc. Mech. Engrs., vol. 38, 1916, p. 8.
National Bureau of Standards, Aluminum Foil Insulation: Letter Circ. NBS LC465.

The price of monazite has fluctuated widely, but until about 1929 it rarely dropped below $20 or $25 a unit of thoria content, or about $120 a ton for 6-percent ore. During the World War and again in 1920 it cost about double these figures, delivered at New York. Quotations of $60 a ton, however, were reported by Engineering and Mining Journal during 1930 for monazite containing a minimum of 6 percent thoria. In July 1932 the basis of quotation was advanced to 8 percent minimum, and less than a year later the quotation was dropped to $50 a ton. The price increased to $60 in 1934, at which figure it remained until the second quarter of 1936 when it was broadened from $60 to $75 a ton.

OLIVINE

Olivine, a natural magnesium silicate of good refractory properties, is abundant in North Carolina where it is produced and shipped by at least three companies. Commercial shipments began about 1930 but were small. Although a relatively new product it seems to be used in increasing quantities by steel companies, and favorable reports have been received as to its performance, particularly in back walls of open-hearth furnaces. Substantial quantities of olivine are also used in shaped refractories, sold under the trade name "Forsterite", which seem to have been satisfactory in the steel industry for open-hearth bulkheads and in various nonferrous metallurgical furnaces for roofs and walls above the slag line. Trials are in progress to test its use for rotary-kiln linings. Several installations of complete burning zones lined with Forsterite brick are now in service in kilns burning portland cement and dolomite. Statistics of production or consumption of olivine are not available for publication, but they have exceeded 5 carloads monthly.

Although Forsterite refractories were introduced in 1933 a considerable tonnage was not shipped until 1935; several thousand tons of these refractories have been shipped in each of the last 2 years.

Forsterite bricks are made by adding a small amount of magnesite to olivine so that their composition approaches that of natural forsterite ($2MgO.SiO_2$). The manufacture of these refractories, which has been fully described in technical literature,[11] is covered by United States patents, and a working arrangement has been made with Prof. V. M. Goldschmidt, who worked on similar materials in Norway in the laboratory of the Government Raw Material Committee in cooperation with the Norwegian Ministry of Trade and Industry. The combination of magnesia with olivine produces a high-temperature-load-carrying refractory. The talc, serpentine, and small amounts of other hydrous impurities that commonly occur in olivine do not tend to lower the softening point.

Cut blocks of natural olivine are available, but sales to date have been largely of crushed rock or rubble. The rock has no definite cleavage, and costs of cutting blocks have been prohibitively high, running from $30 to $40 a ton. Of potential interest is the use of olivine aggregate, prepared in three suitable sizes, with high-alumina cements to make a refractory material that can be cast in place like ordinary concrete.

Owing to the relatively low cost of mining olivine and the fact that the deposits are situated in the eastern part of the United States

[11] Birch, R. E., and Harvey, F. A., Forsterite and Other Magnesium Silicates as Refractories: Jour. Am. Ceram. Soc., vol. 18, no. 6, 1935, pp. 176-192.

reasonably near consuming centers, it is one of the cheapest high-duty refractories capable of withstanding basic slags. For example, at $8 a ton f. o. b. mines, it costs little more than one-third as much as dead-burned magnesite.

Extensive deposits of olivine in the State of Washington likewise may be utilized in the manufacture of firebrick and other refractory material. Deposits occur on Cypress Island, and more than 40 square miles of olivine rock are exposed in the Twin Sisters Mountains east of Bellingham. Investigations at the Northwest Experiment Station of the Bureau of Mines in cooperation with the College of Mines, University of Washington, showed that commercial quantities of this dunite can be secured which contain 47 to 49 percent magnesia. Refractory tests showed a pyrometric cone equivalent of cone 35 (1,785° C.), a loss of weight of less than 2 percent, and a volume shrinkage of less than 2 percent at 1,530° C. Slag tests of olivine block in high-temperature contact with basic open-hearth steel slag have indicated that it has a better resistance than commercial magnesia brick. Tests on the fluxing effect of various materials showed that, of the substances tried, alumina lowered the melting temperature most and iron oxide gave less fluxing action. More than 35 percent of magnesia and 50 percent of chromite were necessary before an appreciable raising of the refractoriness was noted. Petrographic examination showed that synthetic forsterite crystals could be developed at high temperature.

STRONTIUM MINERALS

A general review of the strontium industry appeared in Minerals Yearbook, 1935 (p. 1232). No domestic production of strontium ore has been reported since 1918, and domestic needs are supplied by imports which are shown in the following table.

Strontium minerals and chemicals imported for consumption in the United States, 1925–36

Year	Minerals		Nitrate		Carbonate [1]		Oxide	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1925–29 (average)	2, 567, 658	$43, 123	1, 868, 113	$105,412	52, 346	$3, 249	2, 335	$245
1930	440, 924	10, 459	1, 678, 886	92, 166	33, 978	2, 182		
1931	260	123	1, 701, 750	80, 889	29, 452	2, 022	11, 252	520
1932	11, 685	276	438, 931	18, 699	30, 550	2, 211		
1933	2, 426, 493	8, 457	532, 835	23, 744	10, 073	850	595	115
1934	2, 500, 411	9, 218	237, 105	13, 796	28, 416	3, 284	2, 204	469
1935	2, 674, 094	11. 595	277, 548	15, 716	21, 828	2, 641		
1936	3, 880, 302	14, 537	694, 696	39, 820	[1] 52, 311	[1] 6, 056	([1])	([1])

[1] Oxide included under carbonate.

VERMICULITE

The production of vermiculite in 1936, as reported to the Bureau of Mines by five producers, was 61,770 short tons. Sales aggregated 16,733 tons valued at $184,387, of which 15,596 tons valued at $151,858 were sold crude and 1,137 tons valued at $32,529 were expanded or otherwise processed or refined at or near the mine.

The Montana companies continued to furnish the bulk of the output, notwithstanding greatly increased activity in Wyoming and Colorado. The Universal Insulation Co. marketed a plastic insulating

cement and a light-weight insulating concrete in addition to other vermiculite products. F. E. Schundler & Co., which operates processing plants at Joliet, Ill., and Long Island City, N. Y., completed arrangements in 1936 for exporting vermiculite. An English company, known as British Vermiculite Products, Ltd., has been formed, and an expanding plant installed in Stratford. The Colorado Vermiculite Co., Inc., of Guthrie, Colo., has erected an expanding plant in Fremont County. The Vermiculite Co. of America, Hillside, Colo. (which acquired various properties formerly held by the Allied Minerals Co. of Austin, Minn.), reported grading and cleaning equipment as under construction. The Associated Minerals, Inc., of Austin, Minn., further developed its Colorado property. The Mikolite Co., Kansas City, Mo., not only produces house fill but also a full line of insulating plaster, acoustical plaster, roof insulation, and decorative finishes. This company, after experimenting with raw material from other States, has recently been using Wyoming vermiculite, which is said to differ from other vermiculite in that it expands like a sponge instead of like an accordion. The North Carolina vermiculites are not so readily adaptable for use in loose house fill as the western vermiculites because they are too friable after calcining, but they are used fairly extensively in molded insulation and wallboard; they seem to adhere to a bond better than the more leathery type. Shipments were reported in 1936 by the Georgia-Carolina Minerals Corporation and the Vercolite Corporation, both of Franklin, N. C.

According to a recent report[12] of the Tennessee Valley Authority, the tonnage of individual deposits of high-grade vercimulite in western North Carolina and north Georgia is not as large as was generally supposed a year or so ago. The veins, the best of which are selvage veins along contacts of peridotites and pyroxenites, range in width to a maximum of 25 feet, the average being less than 10 feet. No vermiculite mining has so far extended below 40 feet, as the operations are open-cut and the walls are heavily jointed. Gangue minerals are picked out by hand. If the fines are not wanted, they are removed by being passed over a screen, although, with increased demand for fines free from clay and other impurities, log washers may come into use.

[12] Tennessee Valley Authority, Vermiculite and Bentonite of Tennessee Valley Region: Div. Geol. Bull. 5, Knoxville, Tenn., December 1936, 51 pp.

PART IV. MINE SAFETY

EMPLOYMENT AND ACCIDENTS IN THE MINERAL INDUSTRIES

By W. W. Adams

SUMMARY OUTLINE

A small increase in the number of employees and a slight reduction in the aggregate number of man-hours of employment in the mining and quarrying industry of the United States in 1935 compared with 1934 were shown by reports furnished to the United States Bureau of Mines by operating companies. Preliminary reports for 1936 indicate a further increase in the number of men employed during that year and in the number of man-hours worked.

These statements are based upon an examination of complete reports for 1935 from operators of anthracite and bituminous-coal mines; stone quarries and related plants, such as cement mills, limekilns, rock crushers, and finishing plants; on reports from representative mines producing gold, silver, copper, lead, zinc, or other mineral; and on preliminary returns from various classes of mines and quarries for 1936.

Although the mineral industry includes the milling and smelting of ores, the production of petroleum and natural gas, and the manufacture of coke, statistics now available for 1935 and 1936 only cover mining, quarrying, and the preparation of such rock products as cement, lime, crushed rock, and sawed and finished stone.

Within the field covered by these operations, 697,402 men were employed in 1934, the latest year for which final and complete figures are available. Complete reports for most of the industry and partial reports for certain groups of metal mines indicate that the number of men at work in 1935 was approximately 709,000. Reports for 1936 from a relatively small number of plants suggest that the working force during that year may have reached 756,000 men, but the accuracy of this figure cannot be accepted until returns have been received from a much larger number of companies than have thus far furnished their annual reports to the United States Bureau of Mines. The indication of 756,000 employees in 1936 is based upon

the percentage of increase in employment shown by reports for that year compared with reports from indentical plants operating during 1935.

Coal mining is by far the largest branch of the mining industry in the United States, whether measured by the number of men employed, the number of man-hours of labor performed during a normal year, or the quantity and value of mineral produced; it is also largest when measured by the number of men killed or injured by accidents that

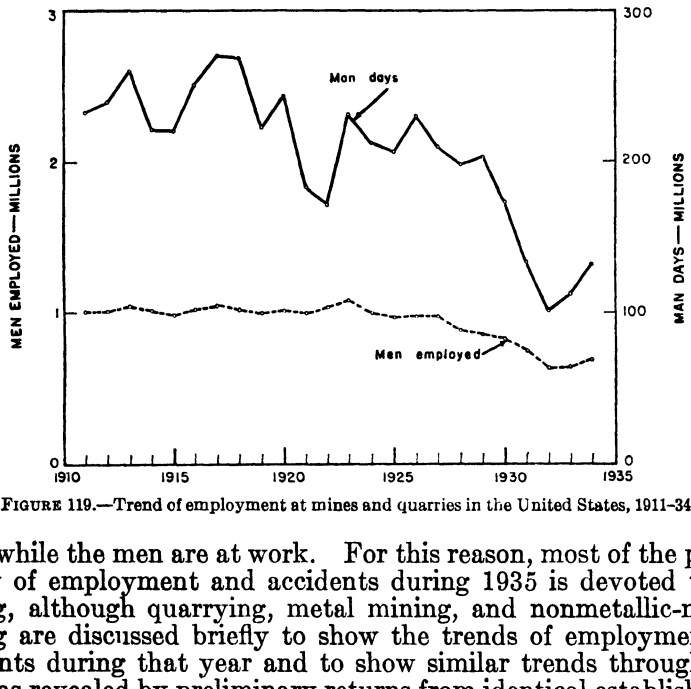


FIGURE 119.—Trend of employment at mines and quarries in the United States, 1911–34.

occur while the men are at work. For this reason, most of the present review of employment and accidents during 1935 is devoted to coal mining, although quarrying, metal mining, and nonmetallic-mineral mining are discussed briefly to show the trends of employment and accidents during that year and to show similar trends through 1936 so far as revealed by preliminary returns from identical establishments that were active both in 1935 and 1936.

Employment and fatal-accident record of the mining and quarrying industries in the United States, 1911–35

Year	Men employed	Man-days worked	Men killed	Fatality rate per thousand 300-day employees	Year	Men employed	Man-days worked	Men killed	Fatality rate per thousand 300-day employees
1911	1,005,281	232,388,227	3,539	4.57	1924	996,983	211,030,846	2,958	4.21
1912	1,004,317	239,067,792	3,293	4.13	1925	967,390	206,286,546	2,754	4.01
1913	1,045,198	259,159,364	3,651	4.23	1926	978,002	229,697,110	3,102	4.05
1914	1,009,236	221,221,292	3,193	4.33	1927	970,393	209,735,874	2,718	3.89
1915	986,866	220,772,734	2,970	4.03	1928	886,364	197,805,128	2,568	3.89
1916	1,016,453	250,403,419	3,096	3.71	1929	858,790	202,049,152	2,663	3.95
1917	1,040,186	269,482,848	3,679	4.10	1930	827,872	172,323,051	2,439	4.25
1918	1,013,364	268,579,236	3,351	3.74	1931	747,262	133,512,008	1,682	3.78
1919	997,336	222,264,681	2,914	3.93	1932	637,777	100,954,646	1,346	4.00
1920	1,007,692	243,873,483	2,875	3.54	1933	642,125	112,229,996	1,218	3.26
1921	994,367	182,698,940	2,345	3.85	1934	697,402	131,771,709	1,402	3.19
1922	1,029,585	171,316,453	2,460	4.31	1935	730,521	136,547,329	1,457	3.20
1923	1,078,270	230,299,402	2,972	3.87					

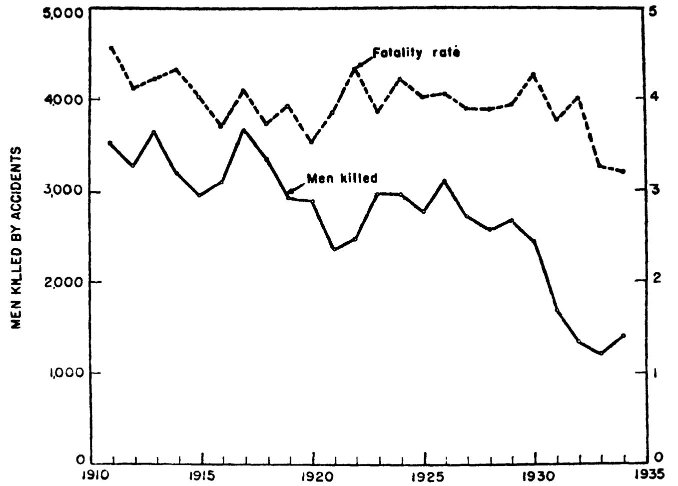


FIGURE 120.—Trend of fatal accidents at mines and quarries in the United States, 1911–34.

EMPLOYMENT AND ACCIDENTS

BITUMINOUS-COAL MINES

Employment.—The total number of men employed in bituminous-coal mining has increased continuously since 1932, when the lowest level of the depression period was reached. In that year the number of workers employed was 406,380, a decrease of 19 percent compared with the working force employed in 1929. Additions to the mine pay rolls during the three succeeding years brought the number of workers employed in 1935 to within 8 percent of the predepression level. Scattering returns from a small number of companies indicate that the number of workers was increased further in 1936.

Outstanding coal-producing States in increasing employment since 1932 are Virginia and West Virginia in the East, Ohio and Michigan in the east north central area, and Missouri, Iowa, and South Dakota in the trans-Mississippi region. In all of these States employment in 1935 was greater than in 1929. On the other hand, employment in both Pennsylvania and Kentucky was still lagging behind the predepression level. Compared with 1929 a decrease of 6 percent is shown in the number of bituminous mine workers employed in Pennsylvania, and Kentucky shows a decrease of 11 percent.

In recent years there has been a marked shortening of the coal miner's workday. Although the trend toward a shorter workday has been evident for many years, 1930 was the first year in which the mining companies were specifically requested to indicate on their reports to the Bureau of Mines the aggregate number of man-hours of work performed at their properties as given on the books of the companies. The returns for that year showed that many companies had not then begun to keep a record of man-hours worked; on the other hand, a large number of companies did keep such records, and they reported the actual book figure to the Bureau. Those that did not maintain man-hour records reported to the Bureau the average number of employees, the number of days on which coal was produced,

and the number of hours constituting a standard working day at the mines; with this information, the number of man-hours worked at these mines was calculated and added to the number of man-hours worked at the other mines where actual book records of man-hours worked were maintained. Complete figures for 1930, as thus reported and calculated, revealed that the bituminous-coal mining industry in the United States operated an average of 8.13 hours per day per man employed in 1930. By 1935 many more companies were maintaining records of man-hours actually worked, and the reports for that year for the entire industry showed an average of 7.03 hours worked per man-day. Incomplete reports for 1936 indicate a slight increase in the length of workday over 1935.

It should be made clear that the total number of employees and the number of hours constituting a workday do not in themselves show the volume of employment in the coal-mining industry. The volume of employment depends, further, on the number of days on which the mines were in operation. Whether a mine is active or idle on a given day is determined largely by the presence or absence of orders for coal on the company's books; yet the working crew, in more or less normal numbers, must stand by and be available for work on any day of the year. In 1930, out of a possible working period of more than 300 days, the actual operating time of all bituminous-coal mines in the United States averaged only 187 days per man. In 1935 each employee averaged only 178 days of work, and even in 1929 the average employee had only 219 days of employment. This part-time employment, if spread over a year of 52 weeks, means that in 1930 the average period of employment was 29 hours per man per week; it was 25 hours in 1934 and 24 hours in 1935. In other words, the average coal miner averages about 3½ 7-hour days per week throughout the year.

The aggregate number of man-hours worked at coal mines rises and falls with the increase and decrease in the quantity of coal produced, except as the relation between the two sets of figures may be affected by the increasing productivity of labor due to increased mechanization and other improvements in methods of production. Upward trends in total production are accompanied by *less*-pronounced upward trends in man-hours worked. By contrast, when the trend of total production is downward, *more*-pronounced downward trends in the number of man-hours worked are observed. The tendency of total man-hours to lag behind total production when the trend is upward and to fall more rapidly when the trend is downward is chiefly due, as previously stated, to the increasing quantity of coal produced per man-hour of labor performed. Production of bituminous coal in the United States reached a maximum in 1918; this was also the year of maximum number of man-hours worked at the mines. Compared with 1918, there was a drop in 1935 of 36 percent in total production and 54 percent in the total number of man-hours worked. In 1918 production averaged 0.463 ton per man-hour worked; in 1935 the average was 0.644 ton, an increase of 39 percent.

Accidents.—Coal mining ranks as one of the most hazardous of the major industries of the United States. Nevertheless, the number of lives lost from accidents has been reduced greatly in recent years. The annual loss of life in bituminous mines during the past 3 years has averaged only about half of what it was 20 years ago. In 1935,

for example, only 968 men were killed compared with 1,683 in 1915; in 1934 there were 958 fatalities compared with 1,859 in 1914; and in 1933 the total was only 833 against 2,167 in 1913.

Although it is clear that fewer men are now being killed by accidents at the mines than formerly, this fact does not necessarily indicate that the present-day coal miner is a better life-insurance risk than was the miner of 20 years ago. To make the individual miner more acceptable to a life-insurance company, his per-capita accident experience must be reduced. Whether or not this has been accomplished is quite independent of the actual number of fatal accidents reported from year to year in the coal-mining industry as a whole. The number of fatal accidents must be considered in relation to the number of men employed and the number of hours the men work in the mines.

Physical conditions underground undoubtedly have been improved. Operators and miners are more safety-minded than they were 20 years ago. Mining machinery is used more extensively than ever before. Machine-loading of coal at the face has largely replaced loading by hand shovel in many mines. Haulage cars and tracks have been improved. There is no doubt that good housekeeping is practiced by more and more coal-mining companies.

These evidences of progress in a large number of mines make possible a larger production of coal bv the average employee for each day or hour he spends at work. Under these conditions it is manifest that fewer men, or at least fewer man-hours, are required to produce a given quantity of coal. With the 1935 average productivity per man-hour the tonnage produced by the entire industry in the prosperous year 1929 could have been produced with 35,000 fewer men than were actually employed that year. Moreover, this could have been accomplished without any change in the working time of the 1929 employee. The production of coal during 1915 could have been made with 165,000 fewer men than were employed during that year, also without any change in the working time of the 1915 employee.

With a reduction in the number of employees or man-hours as the productivity of labor increases, there must be a proportionate reduction in the number of accidents to hold the accident rate per employee or per man-hour to its former level. If the number of accidents is not thus proportionately reduced, the accident rate will rise; if accidents are reduced in greater proportion than men or man-hours, the accident rate will be lowered. From 1915 to 1935 the number of man-hours worked at the mines was reduced 40.8 percent, and the number of men killed was reduced 42.5 percent. Thus, efficiency in safety increased at a more rapid rate than did efficiency in the production of coal, and the fatality rate per million man-hours of employment was reduced from 1.722 to 1.673, a reduction of nearly 3 percent, although the average miner produced 42 percent more coal in an hour in 1935 than he did in 1915.

This point is often overlooked by those who are critical of the coal industry's accident record, and it is equally overlooked by others who are inclined to claim for the industry more credit than it merits.

Could operating conditions in coal mines remain static, we might reasonably expect accident-prevention measures to produce a constant downward trend in the accident rate; but conditions change continually, and the inherent hazards of mining would take an

increasing toll of human life were it not for the safety measures the operators and miners observe in their work. As the per-capita hazards increase with the declining number of employees, safety measures also must increase. Under these conditions, it should be recognized that progress in safety is being made if the accident rate does not rise as fast as the per-capita hazards increase, and especially is this true if the accident rate is kept on its former level. It should be recognized that safety measures are doubly effective when the accident rate per man-hour worked shows a downward trend when the inherent hazards of mining per man employed are increasing.

ANTHRACITE MINES

Employment.—The anthracite mines covered by Bureau of Mines statistics of employment and accidents are situated entirely in the eastern part of the State of Pennsylvania. Data on the few anthracite mines elsewhere in the United States are included with the statistics for bituminous-coal mines. Employment at the anthracite mines in Pennsylvania declined in 1935 compared with 1934, both as to number of workers and man-hours of work performed. Moreover, the average period of employment per man was less than in 1934. Reports from the operating companies showed a total of 102,848 men employed and 154,096,381 man-hours worked in 1935, a reduction of 5 percent and 14 percent, respectively, compared with 1934. The average employee worked 187 days, or 19 days less than the year before. No specific information as to employment is available for 1936.

Accidents.—Reports for 1935 showed that 274 employees were killed and 18,046 were injured by accidents at the mines, breakers, and dredges. These figures indicate a fatality rate of 1.78 per million man-hours of employment compared with 1.50 for the previous year and a nonfatal lost-time injury rate of 117.11 compared with 117.88 for 1934. During the 6 years (1930–35) for which comparable figures are available, the lowest accident rate (113.74) for fatal and nonfatal injuries was that for 1933. Although the combined rate for 1935 was only a fraction less than in 1934 and although it did not compare favorably with the rate for 1933 it was more favorable than the rates for the 3 years preceding 1933.

IRON-ORE MINES

Employment.—A larger volume of work performed and a reduction in the number of men employed was shown for 1935 compared with 1934 by final and complete reports received by the Bureau of Mines from operating companies. The reduction in number of employees was 9 percent, but a 2-percent gain was reported in the aggregate number of man-hours worked during the year. The working time for all operating mines averaged 219 days or 1,758 hours per man compared with 195 days or 1,558 hours per man in the preceding year. An average of 8 hours per shift was reported for both years. Preliminary reports for 1936 indicate large gains in employment over 1935, both in the number of men working and the man-hours of labor performed. According to the returns thus far received, the increase in 1936 over 1935 was probably as much as 30 percent. Notwithstanding this evidence of further recovery from the recent depression, the industry

no longer seems to require the working force it employed 15 or 20 years ago. Maximum employment was reached in the war year, 1917, when the working force was more than 57,000 men and when more than 16 million man-days of labor were required to produce the tonnage of that year. Much of this labor doubtless was utilized to produce iron for purposes connected directly or indirectly with the World War. But even in 1920, more than 45,000 men were employed and more than 13 million man-days were worked. By 1935 the number of employees had been reduced to 14,000 and the number of man-days to approximately 3 million. Although this reduction in employment may be attributed, in part, to the absence of need for iron for war purposes, and partly to incomplete recovery from the depression, perhaps the chief reason for the industry's present ability to operate with fewer men is the fact that methods of operation have been improved and, in consequence, each man-hour of labor is now more productive than formerly. Actual records of productivity per man-hour were not available until 1923, but since that year the output of iron ore in the United States per man-hour of labor performed has been tending upward. Other factors that contribute to a larger output per man-hour are the increasing proportion of total tonnage of ore now being obtained from open-pit mines compared with underground mines and the larger production of ore per man-hour made possible by using large power shovels in open-pit mining.

Accidents.—The iron-ore-mining industry is outstanding among the metal-mining industries of the United States for its low death and injury rates from accidents. In 1935 the accident rate was 18.7 per million man-hours of employment, having been reduced from 20.8 for the previous year. In one respect the record was less favorable than in the preceding year, the fatality rate being 0.89 in 1935 against 0.66 in 1934. Thus, the improvement in 1935 was in the field of nonfatal injuries rather than accidents causing the death of the injured employees. Except for 1932, when the combined accident rate for fatal and nonfatal injuries was 17.0 per million man-hours of employment, the corresponding rate of 18.7 for 1935 was the lowest accident rate and therefore the best safety record that the industry has ever had. The remarkable extent to which accidents have been eliminated from iron-ore mining is indicated by the low accident rates that have prevailed in recent years. So successful have the mining companies been in preventing accidents to their employees that the accident rate for 1935 was 82 percent lower than it was for 1911, the first year for which figures are available. Preliminary reports from the operating companies indicate that the accident rate was higher in 1936 than in 1935, but even if final returns should bear out this apparent increase the rate for 1936 was lower than that for any year preceding 1932.

COPPER MINES

Employment.—Although complete reports for copper mines for 1935 are not yet available, partial returns from the operators indicate substantial gains over 1934 in the number of men working and man-hours worked. Further increases are indicated by preliminary reports from the producing companies for 1936. The improvement in employment was general, virtually all copper-mining districts sharing in the gains. The industry employed 8,084 men in 1934, and it is probable that this figure was increased to approximately 9,500 in 1935.

The total valume of labor performed in 1934 was reported as 14,726,617 man-hours, which apparently was increased to about 20,800,000 man-hours in 1935.

Accidents.—Complete statistics on accidents at copper mines are not yet available for 1935, but incomplete figures show a large increase in the accident rate over 1934. For each million man-hours of employment during 1934, reports from producing companies showed 46.2 accidents. This rate apparently increased to approximately 68 accidents per million man-hours in 1935, and preliminary reports for 1936 indicate a further increase.

LEAD AND ZINC MINES (MISSISSIPPI VALLEY STATES)

Employment.—Figures covering identical mines operating during 1934 and 1935 in Kansas, Missouri, and Oklahoma—the principal lead-zinc producing States of the Mississippi Valley—and covering mines that employ about half the total number of men in the entire region, showed a slight reduction in the number of employees in 1935 and a more material falling off in the number of man-days and man-hours worked. The decreases were in Kansas and Oklahoma. Mines in Missouri reported gains in employees, man-days, and man-hours, but these gains were not extensive enough to overcome a decline in employment in the region as a whole. In 1936, according to preliminary returns, the number of workers and the volume of employment increased, Kansas and Missouri sharing in the gains and Oklahoma reporting a further decline.

Accidents.—Although Oklahoma reported a loss in employment in 1935 it was the only one of the three important lead-zinc producing States in the Mississippi Valley to report a better safety record. The accident rate for Oklahoma was lowered to such an extent that increased rates in Kansas and Missouri were more than overcome, so that the group rate for the three States was lower in 1935 than in 1934. This favorable showing apparently did not continue in 1936, as partial returns indicate higher accident rates for each of the three States and, consequently, for the district as a whole.

GOLD, SILVER, AND MISCELLANEOUS METAL MINES

Employment.—Employment and accident data for this group of mines reflect chiefly the experience of mines that produced gold and silver, but the figures also cover lead and zinc mines operating in States other than those in the Mississippi Valley; the figures also include data for mines that produced minor metals, such as quicksilver, manganese, etc.

Complete figures for this and several other classes of metal mines are not yet available for 1935, owing to the loss of one-third of the Bureau of Mines personnel several years ago and the inability of the small available force to complete the tabulation of returns from mining companies in time for inclusion of the figures in this publication. Such reports as have been tabulated cover approximately 34 percent of all men who work in this class of mines. These reports show increases in the number of employees, man-days, and man-hours for 1935. The increase in number of employees, according to these incomplete figures, was approximately 14 percent, and the gain in number of man-hours worked was about 20 percent.

Accidents.—The accident rate for mines producing gold, silver, and the other metals included in this group was 99.2 per million man-hours of employment in 1934. According to available returns, the rate for 1935 was lower than this, perhaps by as much as 6 percent, which would indicate that the rate will be about 93.3 per million man-hours worked in 1935. Early returns for 1936 indicate an increase over the accident rate for 1935.

NONMETALLIC-MINERAL MINES

Employment.—Included in this group are mines that produce gypsum, phosphate rock, sulphur, or any nonmetallic mineral except coal, sand, gravel, or clay. Nonmetallic-mineral mines, as thus defined, reported a total of 8,339 men employed during 1935 compared with 8,234 men in the previous year. The total working time for all employees equaled 16,168,307 man-hours, an increase of a little more than 6 percent over 1934. The average employee was at work 1,939 hours during the year, which compares favorably with the previous year's average of 1,844. No data are available for 1936 for mines included in this group.

Accidents.—The mining of other nonmetallic minerals is usually attended by fewer accidents in proportion to the volume of employment than is the mining of coal, and, with the exception of iron mining, the record for the nonmetallic group is also usually more favorable than that of metal mines. The accident rate for mines in the nonmetallic group was 50.7 per million man-hours of employment in 1935, a reduction from the rate of 52.3 for the year 1934. Reports have not yet been compiled to reveal the rate for 1936.

CEMENT

Employment.—A slight reduction in the number of employees engaged in quarrying and an equally slight increase in the number of men working at the cement mills were reported by the operating companies for 1935. The reduction and increase extended to the number of man-hours worked at the quarries and mills, respectively, a net increase being reported for the industry as a whole. The returns for both quarries and mills showed 24,416 men employed and 39,243,018 man-hours worked, the average working time per employee being 227 days (1,607 man-hours). A further increase in the number of workers and a very material increase in the number of man-hours worked were shown for 1936 by reports that, though not covering all companies, reflect conditions in more than 80 percent of the industry based on the number of men employed.

Accidents.—The cement industry ranks as the leader in safety among the various stone-quarrying industries of the United States. For a number of years the accident rate for cement mills and quarries has been low, much lower than for any other important branch of the quarrying industry. The rate for 1934, which represented 12.6 lost-time accidents per million man-hours of employment, was lowered to 9.5 in 1935, a reduction of more than 24 percent. Unfortunately, the accident rate increased in 1936, according to incomplete returns for that year, the reports indicating an increase large enough to raise the rate for the year back approximately to that for 1934.

153336—37——93

LIMESTONE

Employment.—The number of men employed at quarries that produce limestone for purposes other than the manufacture of cement was 30,973 in 1935. This number is not strictly comparable with the number (24,119) reported for 1934 because many small operations were canvassed for 1935 that were not canvassed in the preceding year. Statistics for identical plants that were active during both years indicate that the number of employees was slightly less in 1935 than in 1934 and that there was also a small reduction in the number of man-hours of labor performed. The entire canvass for 1935 showed a total of 45,197,391 man-hours worked, an average of 1,459 hours per employee. A slight reduction in the length of the workday was reported, from 8.1 hours per day in 1934 to 7.8 hours per day in 1935, based upon reports for identical plants. A few reports showed more employment in 1936, both in total number of employees and total number of man-hours worked, over the record of the identical establishments for 1935.

Accidents.—Progress was reported in preventing accidents in 1935 compared with 1934, both as to all establishments canvassed for those 2 years and as to identical establishments active in 1934 and 1935. The accident rate was reduced from 57.3 fatal and nonfatal lost-time injuries per million man-hours of employment in 1934 to 53.9 per million hours in 1935, with preliminary reports for 1936 indicating a further slight improvement over the 1935 record.

MARBLE

Employment.—With approximately the same number of men working as in the preceding year, companies engaged in the operation of marble quarries and finishing plants reported a substantial gain in the number of man-hours worked in 1935. The average number of men employed was 2,441 compared with 2,488 in 1934, but the volume of employment, as measured by the number of man-hours of labor performed during the year, increased from 3,508,983 in 1934 to 4,016,819 in 1935, a gain of 14 percent. The average employee worked 1,646 hours during the year, a gain of 236 hours over the average number of hours worked in the preceding year. The average length of working day, weighted for all plants and for all men, was 7.8 hours, a slight increase over the average of 7.5 hours per day in 1934. Information available for 1936 and covering about two-thirds of the men employed in the marble industry shows an increase in employment in 1936 over 1935.

Accidents.—One fatal accident and 176 nonfatal lost-time injuries occurred among the employees at marble quarries and plants during 1935. These figures indicate an accident rate of 44.1 per million man-hours of employment compared with a rate of 43.3 for the preceding year. Preliminary reports for 1936 present a material reduction in the accident rate for that year.

SANDSTONE

Employment.—Reports from companies engaged in the production of sandstone during 1935 showed an average working force of 2,739 men and a total of 3,688,135 man-hours of labor performed. As these figures cover some companies that had not previously been

included in the Bureau's annual employment canvasses they are not entirely comparable with similar figures for 1934. Reports from identical companies for both years showed approximately the same number of employees in 1935 as in the previous year, but they also showed an increase of 8 percent in the total number of man-hours worked. The identical companies reporting this increase in man-hours worked represented about half of the industry. Complete reports from all companies operating during 1935 showed an average period of employment of 167 days or 1,347 hours per man and an average daily shift of 8.1 hours.

Accidents.—The accident rate for the sandstone industry remained virtually unchanged in 1935, whether measured by reports from identical companies or by comparing the complete canvass for 1935 with the somewhat less complete canvass for 1934. Complete returns for 1935 showed that 243 men had been injured by nonfatal accidents. The accident rate for the year was 65.9 per million man-hours of employment compared with 64 for 1934. Information for 1936 is still too meager to indicate the accident rate for that year.

GRANITE

Employment.—Granite quarries and finishing plants reported a reduction in the number of employees and in the number of man-hours worked in 1935 compared with 1934. That these losses were recovered in 1936, however, is indicated by preliminary reports for that year which represent something less than one-fifth of the industry. As far as may be judged from these early reports, the gain over 1935 was about 20 percent in number of men employed and approximately 27 percent in number of man-hours worked. Final statistics for 1935 showed 6,877 employees and 10,555,416 man-hours of work performed compared with 7,807 men and 11,000,155 man-hours in 1934. The aggregate working time for all plants in 1935 averaged 1,535 hours per man employed. The weighted average length of workday was 7.6 hours. These figures represent more hours of work per man for the year and a slightly longer workday, as the reports for 1934 showed 1,409 hours per man and an average workday of 7.3 hours.

Accidents.—The industry's safety record improved in 1935, according to final reports from the operating companies, which revealed a rate of 54.6 per million man-hours worked in 1935, as against 71.9 in 1934. A further slight reduction in the accident rate is shown by partial returns for 1936.

TRAP ROCK

Employment.—Reports from operators of trap-rock quarries for 1935 showed a total of 3,496 men employed and 4,235,223 man-hours of labor performed. These figures represent a large increase both in number of employees and in man-hours worked over the corresponding statistics for 1934. However, as the canvass of the industry was more complete in 1935 than in the preceding year, the larger number of reporting companies for 1935 must be responsible for some of the increase. That the industry distinctly improved in 1935 is shown by the reports from operating companies, which revealed a much larger quantity of stone produced during 1935 than in the preceding year. Although the output of building stone declined in 1935, a very marked

increase occurred in the quantity of rubble produced.[1] The reports from operating companies for 1935, which, as stated, are more complete than those of the previous year, showed an average working time of 154 days, or 1,211 hours of employment, per man.

Accidents.—Accidents at trap-rock quarries were reduced to a marked degree in 1935, as shown by a substantial lowering of the accident rate per million man-hours of employment. For the industry as a whole the rate was 53.6, a reduction of 34 percent from the previous year's rate of 81.1. This improvement corresponds with that shown by reports from identical establishments for the 2 years, which showed a rate of 66.7 for 1934 and 42.1 for 1935.

SLATE

Employment.—Reports from operators of slate quarries for 1935 revealed a total working force of 2,063 men and a volume of employment equal to 3,097,339 man-hours of labor. These figures indicate that the average employee worked 1,501 hours during the year. The plants were in operation for an average of 184 days per man, the average working shift being 8.2 hours. As the Bureau of Mines canvass of the slate industry was more complete in 1935 than in 1934, statistics for 1935 are not entirely comparable with those for the previous year. Identical establishments operated during both years showed substantial gains in number of men working and in number of man-days and man-hours of labor performed in 1935. Even larger increases in number of employees, man-days, and man-hours over the record for 1934 are indicated by complete returns for 1935 due to the increase in number of establishments that reported for 1935.

Accidents.—The accident rate for slate quarries was higher in 1935 than in 1934. This fact is revealed by reports covering identical plants that were active during both years; the reports show a rate of 58.0 per million man-hours worked in 1934 and 62.8 per million man-hours in 1935. The entire canvass for 1935 revealed an accident rate of 54.9 compared with 58.1, as given by the somewhat less complete canvass for the preceding year.

CONCLUSION

The mining and quarrying industries of the United States apparently have achieved efficiency of operation that no longer demands so large a number of workers as were employed heretofore. Complete statistics for the industry, beginning with 1911, show a total of 1,005,281 men employed. The number reached a maximum in 1923, when 1,078,270 employees were reported to the Bureau of Mines by the operating companies. Only 637,777 workers were employed in 1932, the lowest number. An upward trend brought the number of employees to 697,402 in 1934, the latest year for which complete data are available. As stated previously, this figure was increased further in 1935 and 1936, according to reports for 1935 from nearly all operating companies and according to preliminary returns for 1936.

Maximum employment, as indicated by the number of man-days of labor performed, a standard of measurement used in the absence of a long-time record of man-hours worked, was reached in 1917 during

[1] Oliver Bowles, Carl A. Gnam, and A. T. Coons, Stone: Minerals Yearbook, 1936, Bureau of Mines, p. 820.

the World War, when operating companies reported 269,482,848 man-days. This number declined to a minimum of 100,954,646 man-days in 1932, when the number of workers was also lowest. Employment increased to 131,771,709 man-days in 1934, and was increased further in the 2 years following, according to reports now available but not complete for the entire industry.

The death rate from accidents has been reduced 30 percent since 1911, and it was lower in 1934 than ever before. Likewise, the non-fatal-injury rate was lower in 1934 than at any time since 1930, the earliest year covered by reports of injuries for all branches of mining and quarrying.

If the most favorable fatality rate (that reported for 1934) had prevailed during all years since 1911, nearly 13,000 lives would have been saved during that period. The actual number of fatalities during the 24-year period 1911 to 1934 was 65,188. This number would have been 52,337 if the rate for 1934 had prevailed.

What the long-time trend of employment and accidents in the mineral industries may prove to be is perhaps impossible to forecast because of the impossibility of determining the effects of varying trends of technological improvements in methods of mining, of operating mines with leaner ore bodies and thinner seams of coal, of the character of labor force that future working conditions may attract to the mines, of substitution of mineral products with changing prices, and of unpredictable markets for mineral commodities. There can be little doubt, however, that the next decade or so will witness only moderate increases in the number of men employed, with relatively larger increases in total man-hours worked to meet unusual demands for larger quantities of mineral products. Small increases in the demand for minerals may be met by the increasing productivity of labor per man-hour worked.

In the realm of safety, fewer accidents may be expected in proportion to the number of men employed. Recognition of the hazards involved in mining has spread to large sections of the industry, not only among the masses of workers but among supervisory officials and owners of mines. Although the value of mechanical safeguards is not to be discounted, accident prevention is largely a matter of safety education of mining officials and their employees. The progress the mining industry has made during the past few years in lowering the death and injury rate from accidents should be credited more to safety education than to any other single factor. As long as safety education is continued without interruption, a downward trend in the industry's accident rate may be expected. The greatest danger that can threaten the safety movement in mining is the false idea that the movement may proceed temporarily under its own momentum when funds are low and profits small or nonexistent.

INDEX

By M. E. Winslow

M

W

Y

O